A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1935.

GENERAL PHYSICS.

ADSORPTION.

4037. Adsorption of Light and Heavy Hydrogen in Union with Hydrogenation of Ethylene. R. Klar. *Zeits. f. phys. Chem.* 174. *Abt. A.* 1. *pp.* 1–14, 1935.—The velocities of hydrogenation of C_2H_4 with H_2 (K_H) and D_2 (K_D) between 0 and 175° with Fe catalyst, show maxima for K_H at 125°, for K_D at 150°, K_D being $< K_H$ below, and $>$ above 100°. The ratio K_H/K_D is a maximum at 53–55°. The heat of activation (H_C) for hydrogenation with H is 10 k.cal., with D below 50° 8, above, 12·5, the increase is due to interchange between D and H in the activated molecule C_2H_4. H_C of H for deformation- and atomic-adsorption are respectively 1·49 and 10·5 k.cal., of D 2·37 and 12·3, of C_2H_4 12·5 k.cal. The mechanism of the reaction is discussed in the light of these and previous results. Below 50° it is of the first order, only H or D being activated, above of the second order, dependent also on the concentration of C_2H_4. On Ni at $-$ 173° the adsorption is mainly physical, heat thereof (H_D) 1·6 k.cal., $H_C < 0·05$, at 0° chemiadsorption appears, first as deformation-adsorption (H_D 20–25, H_C 1·5), at 200° as atomic adsorption (H_C 15 k.cal.). C. A. S.

4038. Adsorption of Atmospheric Ions at Active Carbon. W. Zimmerschied. *Kolloid Zeits.* 72. *pp.* 135–151, *Aug.*, 1935.—The adsorption of ions from air (ionised artificially by means of a Bunsen burner) at three different active carbons, each of three granule-sizes, is examined. The lighter ions are adsorbed more strongly than the heavier ones, the number of adsorbed ions being proportional to the ion density. The three carbons show only slight differences in activity, but the number of ions adsorbed increases as the size of the carbon granules diminishes. It is, therefore, assumed that the ions, whose radii lie between 0·8 and $5·5 \times 10^{-6}$ cm., are adsorbed mainly at the outer surface of the carbon and not in the fine pores. The velocity with which the ions are sucked through the carbon plays some part, increasing the adsorption. The size relationships of the carbon granules are insufficiently well defined to allow of accurate investigation of the constitution of the ions. T. H. P.

✱4039. Sorption of Water Vapour on Cellulosic Materials. E. Filby and O. Maass. *Canad. J. of Research,* 13. *Sect. B. pp.* 1–10, *July,* 1935.—A direct method used for measuring the adsorption of water vapour on cellulosic materials and in which a number of improvements have been made is described. It is ensured that no vapours other than water are present no matter how long a time is required for the establishment of equilibrium. The adsorption and desorption isotherms of standard cellulose, spruce wood, surgical cotton, Kodak rag cellulose and bleached sulphite have been measured, and the data which indicate the time required for the establishment of true equilibrium have been given. The data of Urquhart and Williams for standard cellulose determined by an indirect method in 1926 have been shown to be correct. AUTHORS.

See also Abstract 4059.

ATOMIC AND MOLECULAR STRUCTURE.

4040. Quantum Steps of Neutrons in Nuclei. T. Hikosaka. *Tohoku Univ. Sci. Reports*, 24. *pp*. 208–221, *July*, 1935. *In German.*—Assuming a simplified model of the nucleus, the author calculates the energies of the neutron quantum states in the case of nuclei of atoms of even atomic number and discusses the dependence of the energy on the α-particle content of the nucleus. W. E. P.

4041. Atomic Nuclei. Radioactivity. Part I. G. Hoffmann. *Die Physik*, 3. 3. *pp*. 109–132, 1935.—A summary dealing with artificial disintegration, artificial radioactivity and recent developments in natural radioactivity. W. E. P.

4042. Disintegration of Neon by Neutrons. R. Jaeckel. *Zeits. f. Physik*, 96. 3–4. *pp*. 151–162, *Aug*. 22, 1935.—The author discusses the transformations that may be expected in the disintegration of Ne by neutrons and describes investigations carried out with a Wilson chamber to determine whether disintegration with proton emission occurs. It was found that α-particles were emitted in all the observed transformations, no evidence of proton emission being obtained. The values of the energy released in a disintegration fall roughly into two groups. The disintegration consists of the transformation of Ne^{20}_{10} into O^{17}_{8}, the two energy groups corresponding to two energy levels in O^{17}_{8}. The maximum energy of the neutrons emitted by the Be-Po source was found to be 10×10^6 V. W. E. P.

4043. Nuclear Photoelectric Effect. J. Chadwick and M. Goldhaber. *Roy. Soc., Proc.* 151*A*. *pp*. 479–493, *Sept*. 2, 1935.—A description is given of the experimental arrangements used to detect the protons and neutrons produced by the disintegration of the deuton by γ-rays of radiothorium and radium [see Abstract 4371 (1934)]. From the energy of the protons released by a γ-ray of $h\nu = 2\cdot 62 \times 10^6$ eV the binding energy of the deuton was found to be $2\cdot 1 \times 10^6$ eV or $0\cdot 0023$ mass units. Using disintegration data, the mass of the neutron is $1\cdot 0084$; using Aston's recent values, the mass is $1\cdot 0090$. The neutron appears to be definitely heavier than the hydrogen atom. The probability of " photo "-disintegration of the deuton was measured approximately and found to agree satisfactorily with theoretical calculations. Rough investigations of the angular distribution of the " photo "-neutrons show that more neutrons are emitted in a direction at right angles to the γ-ray beam than in the forward direction. Experiments with Be are described which suggest that the reaction $\mathrm{Be}^9 + h\nu \rightarrow \mathrm{Be}^8 + n^1$ predominates. The " photo "-neutrons from Be have a different angular distribution from those of deuterium. No evidence of nuclear photo-disintegration was observed in other elements. W. E. P.

4044. Transmutation Functions for Deuton-Induced Radioactivity. E. O. Lawrence, E. McMillan and R. L. Thornton. *Phys. Rev.* 48. *pp*. 493–499, *Sept*. 15, 1935.—When nuclei are bombarded with deutons, the reaction usually results in proton emission and the conversion of the nuclei into isotopes of mass number one unit greater. Many such reactions give β-radioactive products. The variation of the transmutation cross-section with deuton energy has been studied for the radioactivity thus produced in Na, Al, Si and Cu, with deuton energies ranging from 0 to $3\cdot 6$ MV. In all these cases the excitation curve is too flat to be explained by the Gamow theory, while it is fitted very well by a theoretical curve derived by Oppenheimer and Phillips. This is based on the idea that the nucleus can capture the neutron from the deuton without requiring the penetration of the deuton through the nuclear Coulomb barrier. The form of the theoretical curve depends on the binding energy of the deuton; a value between 2·0 and 2·4 MV is required by the experimental results. [See following Abstract.] AUTHORS.

4045. Transmutation Function for Deutons. J. R. Oppenheimer and M. Phillips. *Phys. Rev.* 48. 500–502, *Sept.* 15, 1935.—The effect is considered of the finite size and ready polarisability of the deuton on the probability of transmutations involving the capture of the neutron. These have as a consequence that the Coulomb repulsion of the nucleus is less effective than for α-particles or protons, and that the corresponding transmutation functions increase less rapidly with deuton energy. The collision is treated by the adiabatic approximation and quantitative results are obtained for this energy dependence which are in good agreement with experiment. [See preceding Abstract.] AUTHORS.

4046. Fractionation of the Isotopes of Oxygen in a Commercial Electrolyser. E. R. Smith and M. Wojciechowski. *Bureau of Standards, J. of Research,* 15. *pp.* 187–188, *Aug.,* 1935.—The electrolytic fractionation factor for O^{16} and O^{18}, defined as the ratio of O^{18}/O^{16} in the electrolyte to the same ratio in the oxygen gas evolved by electrolysis, has been found to be 1·05. An isotopic analysis of "equilibrium water" from a commercial electrolyser indicates that about 11 p.p.m. of the increase in density is a result of enrichment in heavy oxygen, and the value of 31 p.p.m. previously reported is incorrect. [See Abstract 4789 (1934).]
AUTHORS.

4047. Hydrogen Isotopes in Petroleum. N. S. Filippova. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 1. *pp.* 29–30, 1935. *In English.*—In connection with this subject Dole's data [see Abstract 2680 (1934)] showed that from the ratio of H isotopes in benzene derived from the dry distillation of coal, in kerosene, and in honey, all these substances have an increased content of deuterium as compared with that of water. Dole, however, concluded that the enrichment with deuterium cannot be regarded as due to the natural separation of isotopes but should be ascribed to fractional condensation of water vapours due to combustion of these substances in passing through a condenser. The present paper records experiments on the combustion of Makhach-Kala motor petroleum and the analysis of the resulting water. The results indicate the natural separation of the isotopes in motor petroleum. When Dole's method was followed the combustion products collected in a condenser showed a considerably greater concentration of deuterium and it is possible that in this case fractional condensation actually occurred.
H. H. Ho.

4048. Isotopes of Arsenic, Selenium, Mercury and Lead. H. J. Walke. *Phil. Mag.* 20. *pp.* 479–481, *Sept.,* 1935.—Arguments are adduced pointing to ${}^{203}_{80}\text{Hg}$ and ${}^{203}_{81}\text{Tl}$ being weakly β-radioactive, or implying that ${}^{203}_{81}\text{Tl}$ is stable and that ${}^{202}_{82}\text{Pb}$ should exist as a stable isotope. An alternative explanation of the existence of ${}^{74}_{34}\text{Se}$ is that ${}^{77}_{33}\text{As}$ was of sufficiently long life to allow of the formation of ${}^{78}_{33}\text{As}$ by neutron capture, followed by ${}^{78}_{33}\text{As} \xrightarrow{\beta} {}^{78}_{34}\overset{\times}{\text{Se}} \xrightarrow{\alpha} {}^{74}_{32}\overset{\times}{\text{Ge}} \xrightarrow{\beta} {}^{74}_{33}\text{As} \xrightarrow{\beta} {}^{74}_{34}\text{Se}$, (${}^{78}_{34}\overset{\times}{\text{Se}}$ and ${}^{74}_{32}\overset{\times}{\text{Ge}}$ being activated) requiring that ${}^{73}_{32}\text{Ge}$ be stable and As a single element of mass 75. C. A. S.

4049. Chemical Forces from the Standpoint of Quantum Mechanics. Part II. W. Jost. *Zeits. f. Elektrochem.* 41. *pp.* 667–674. *Sept.*, 1935.—Part I [see Abstract 4791 (1934)] contained a qualitative treatment of the homopolar chemical bond and the present paper reviews attempts at furnishing a quantitative expression for the known properties of the bond. The following subjects are discussed: the Thomas-Fermi atomic model, wave-mechanics, the Heitler-London treatment of the reciprocal effect between two H atoms, compounds containing polyvalent atoms with special reference to the bonds of organic chemistry, and resonance energies. Tables of bond energies by Pauling are included for single, double, and triple bonds, for benzene derivatives, for condensed ring systems and for the resonance energies of free radicals such as triphenylmethyl. In the latter connection Hückel's work is discussed, and a Bibliography is included. H. H. Ho.

4050. Electronic Structures of Polyatomic Molecules. Part X. Aldehydes, Ketones and Related Molecules. Part XI. Electroaffinity, Molecular Orbitals and Dipole Moments. Part XII. Polyatomic Applications. R. S. Mulliken. *J. Chem. Phys.* 3. *pp.* 564–591, *Sept.*, 1935.—In Part X, electron configurations for the normal states of H_2CO, CH_3HCO, and Cl_2CO are explicitly given, also for the low excited states of H_2CO. The structures, ionisation potentials, and longest wave-length electronic band spectra of these and other related or analogous molecules (saturated aldehydes, ketones, thioaldehydes, thioketones, etc.) are interpreted in relation to these configurations. In Part XI, a convenient criterion for defining equal electronegativity of two atoms is stated in terms of molecular orbitals. Connections between relative electronegativities, coefficients in orbitals, effective charges on atoms in partially polar molecules, and dipole moments are then analysed, and various equations are obtained and applied to polyatomic as well as diatomic molecules. Various scales of electronegativity are discussed. The necessary existence is shown of a " homopolar dipole " contribution to the electric moment of any bond, provided the atoms connected are of unequal size. Dipole moments of H_2O, NH_3 and HX are briefly discussed and it is concluded that the dipole moment scale of electronegativity is probably not well-founded. It is shown how electroaffinity and other data can be used in the approximate determination of the polarities of molecular orbitals and so of bonds. Applications are made to the electronic structures of HI, HI^+, HO^-, ClO^-. In Part XII applications and extensions are made of the results. Applications are made to CH_4, CX_4, H_2O, CH_3X, NH_4^+, ClO_4^-, etc. [For Part IX see Abstract 3723 (1935).] A. C. M.

4051. Function of Hydrogen in Intermolecular Forces. J. D. Bernal and H. D. Megaw. *Roy. Soc., Proc.* 151*A*. *pp.* 384–420, *Sept.* 2, 1935.—From a consideration of the known crystal structures of the metallic hydroxides, it is shown that the force between hydroxyl groups is a function of the size and charge of the kation with which they are linked. When the ion is small and highly charged this force acquires the character of a secondary valency only less powerful than the H bond of acids. This bond, of length about 2·7–2·8 Å, is called the hydroxyl bond, and an attempt is made to explain its occurrence in terms of changes in the internal electronic structure of the hydroxyl group. As in ice, the polarised hydroxyl group is assumed to have a tetrahedral structure with a negative region which serves to bind the positive H atom of a neighbouring hydroxyl. The hypothesis of the hydrogen bond is used to interpret the structures of complex hydroxides and in one case, $Te(OH)_6$, to predict the structure. Possible applications of the idea to organic and colloid chemistry are suggested. T. H. P.

4052. Molecular Polarisation and Association. W. Herold. *Zeits. f. phys. Chem.* 29. *Abt.B.* 4. *pp.* 259–273, 1935.—The orientation polarisation and concentration of double molecules can be estimated by means of a formula connecting these with the concentration variation of the molecular polarisation provided that only double molecules occur. This is applied to Parts' measurements for normal, iso-, secondary and tertiary butyl halides in benzene and show that within the particular concentration range only double molecules are formed. It is possible that association is of two kinds; the complexes being formed with parallel and anti-parallel placings of the moments of association partners. The heat of formation of these complexes is calculated and shown to be a function of the molecular configuration. [See also Abstract 4793 (1934).] W. R. A.

See also Abstracts 4053, 4062, 4069, 4114, 4195, 4197, 4232, 4252, 4266, 4267, 4270, 4271, 4272, 4288, 4310, 4326, 4390, 4401.

COLLOIDS.

4053. Meta Structures of Matter. W. Ostwald. *Kolloid Beihefte*, 42. 4–9. *pp.* 109–124, *Aug.* 1, 1935.—A survey of colloidal chemistry, with the separate identity of non-crystalline matter as its main thesis, considered in 5 Parts, as follows: Part I consists mainly of a dimensional study of micro- and macro-structures, and ranges in treatment from electrons to atoms, molecules, and fixed stars. Emphasis is laid on the existence of intermediate or meta-structures having dimensions between those of light waves and molecules. Part II contains a lengthy discussion of the film, thread, and disperse states of matter, and of boundary systems between them. An instructive table of such systems and a diagram of structures are included. Part III briefly touches on swarm structures. Part IV discusses the thesis that meta-structures are not merely simple summations or averages of microscopic and molecular structures, but have separate identities with their own special characteristics. Part V deals with the latter. H. H. Ho.

4054. Electrical Streaming Potential with Turbulent Streaming. H. Reichardt. *Zeits. f. phys. Chem.* 174. *Abt.A.* 1. *pp.* 15–21, 1935.—Consideration of the conditions in the boundary layer indicates that, even with turbulence in the interior of a tube, the streaming in the double layer remains a viscous streaming, and that, therefore, the Helmholtz equation for streaming potential holds also in the case of turbulent streaming. The experimental data show that the ratio of streaming potential to difference of pressure is constant, independently of the form of the streaming. T. H. P.

4055. Electrical Properties of Colloidal Solutions. Part V. I. N. Mukherjee and S. Mukherjee. *Kolloid Zeits.* 72. *pp.* 178–186, *Aug.*, 1935.—In reply to Pauli and Valkó's criticisms [see Abstract 1783 (1934)], the assumptions made in the deduction of the author's equation for the electric adsorption of ions [see Abstract 2694 (1934)] are discussed and the equation justified. The limitations of Pauli and Engel's transport method ("Elektrochemie der Kolloide," pp. 165–166, Berlin, 1929) are discussed in detail and the former criticism of this method confirmed. The necessity for a clear conception of the valency of a colloid ion is emphasised, and experimental observations are recorded which indicate the peculiarities of such systems. The properties of colloidal solutions of acidic substances are compared with those of polybasic acids in true solution. T. H. P.

4056. Isoelectric Point of Gelatin. R. A. Dulitzkaja and S. I. Sokoloff. *Kolloid Zeits.* 72. *pp.* 205–211, *Aug.*, 1935.—To determine why the isoelectric point of gelatin varies according to its mode of production the isolelectric point of three kinds of gelatin has been determined, namely for (1) " Goldmarke " gelatin (Kahlbaum); (2) that made by treating pigskin with alkali ash, and (3) a gelatin derived from the same source but treated with acid instead of ashes. The determinations were carried out by the catalphoretic process, the nephelometer and the viscometer. The average values obtained for the isolelectric point are for " Goldmarke " 4·87; for ashed gelatin from pigskin, 5·09; and for acid treated gelatin, 5·65–6·08. For the first two gelatin samples, the three methods gave identical results, but for the acid-treated gelatin distinct deviations in data were obtained; indeed, the cataphoretic method can be distinguished from the indirect methods. Potentiometric investigations of all three gelatins were carried out and these showed a characteristic difference of the acid and alkali quantities bound to the gelatin. It is deduced that natural, unchanged (non-ashed) collagen has a higher isoelectric point than gelatin and that the lowering of the isoelectric point by partial hydrolysis can be put down to a change in ratio of acid and basic groups. The degree of hydrolysis can vary and is higher by potash treatment than by acid treatment. J. K.

4057. Particle Size and Cataphoretic Mobility. I. Kemp. *Faraday Soc., Trans.* 31. *pp.* 1347–1357, *Sept.*, 1935.—A review of the present state of the theory of cataphoresis is given. The relation between cataphoretic mobility and particle size has been investigated for particles of gamboge and of silica in solutions of potassium chloride of varying concentrations. The experimentally determined relation is in agreement with that predicted by the formula of Henry over a range of $\kappa b\ 2 - 330$, the discrepancy being within experimental error (circa, ± 5 %). AUTHOR.

4058. Thermal Investigation of the $Al(OH)_3$—Al_2O_3 Transformation by the Emanation Method. R. Jagitsch. *Zeits. f. phys. Chem.* 174. *Abt.A.* 1. *pp.* 49–59, 1935.—Various preparations of aluminium hydroxide have been examined by the emanation method with regard to their behaviour when heated to 20° to 1300° C. The velocity with which the $Al(OH)_3$ first precipitated undergoes transformation increases considerably as the temperature of precipitation is raised. During the heating of the precipitate, the greatest development of surface occurs within the region (200° to 300° C.) where γ-Al OOH is stable. At higher temperatures the γ-Al_2O_3 formed shows gradual diminution in activity, corresponding with diminution of the surface. At about 1100°–1200° C. the emanation indicates rapid structural alteration, which X-ray examination shows to be conversion of γ- into α-Al_2O_3. T. H. P.

4059. Influence of Surface Tension on the Structure of Silica Gel. W. S. Wesselowski and I. A. Selajew. *Kolloid Zeits.* 72. *pp.* 197–202, *Aug.*, 1935.—An investigation of the influence of the conditions of drying of the hydrogel on the porosity of the resulting xerogel. It is demonstrated that the surface tension of the intercellular fluid is one of the most important factors regulating the powers of adsorption of silicic acid gel. The surface tension can be controlled either thermally or by the introduction of a capillary active substance. Heating to 65° C. in itself has little influence on the porosity of the xerogel. Above 65° C. a consolidation of the gel structure takes place and a large-pored gel results. Alkaline hydrogel possesses a more compact structure than acid and produces xerogel with more abundant pores. Such factors as the SiO_2 concentration in the original hydrogel, its ageing and hydration after the incidence of synæresis are, in practice, negligible in effect. P. H. B.

4060. Theory of Liesegang Rings. E. B. Hughes. *Kolloid Zeits.* 72. *pp.* 212–216, *Aug.*, 1935.—By making use of theoretical considerations and the Eversole and Doughty equation it is shown that there must be a correspondence between concentration and diffusion of the electrolyte, and that the ratio between these two quantities can be calculated. The theoretical values obtained agree well with those obtained by direct measurements of ring distances. [See Abstract 2808 (1935).] J. K.

4061. Periodic Precipitations (Liesegang Rings). L. May. *Kolloid Zeits.* 72. *pp.* 217–221, *Aug.*, 1935.—Two investigations have been carried out to confirm Wo. Ostwald's theory on Liesegang's rings. It is shown that the theory only embraces a limited periodicity, but by taking into consideration a physical reversibility, the existence of which has been shown by the present work, the theory of periodic phenomena can be definitely broadened and generalised. New Liesegang rings have been produced, one of particular interest being the periodic formation of $PbO.PbI_2 - PbI_2$. J. K.

4062. Fine Structure of Wood. H. Saechtling and H. Zocher. *Kolloid Zeits.* 72. *pp.* 336–345, *Sept.*, 1935.—The absorption of any one swelling agent, with lowering of the vapour pressure, proceeds similarly for wood and lignin. One type of absorption isotherm is given by benzene, ether and acetone, and another by methanol, water, and, possibly, pyridine. Quantitatively, however, the absorptions of the different liquids by wood and by lignin differ considerably. Calculation of the proportions of the total absorptions due to the separate components of the cell-wall of the wood shows that absorption by the lignin is especially great with ether or acetone, whereas with methanol and particularly with water the part played by the cellulose predominates. [See Abstract 547 (1935).] T. H. P.

See also Abstract 4215.

CRYSTAL STRUCTURE AND PROPERTIES.

4063. Fundamental Theoretical Crystallography. W. Kleber. *Naturwiss.* 23. *pp.* 606–608, *Aug.* 30, 1935.—The bearing of recent results regarding vicinal faces and etch figures on the fundamental nature of the crystal face and the limits of its definability, as also their connection with structural inhomogeneities within the crystal and the discrepancy between its actual and theoretical strength are discussed. The necessity of introducing statistical and probability considerations into the strict mathematical theory is urged. C. A. S.

4064. Energy Levels of Electrons in Crystals. P. Tartakowsky. *Zeits. f. Physik*, 96. 3–6. *pp.* 191–197, *Aug.* 22, 1935.—Schemes of energy levels of the electrons in NaCl, KCl and diamond crystals are proposed, from a consideration of the various experimental results already available. D. H. F.

4065. Advantages of the Four-Index Notation for Crystals of Rhombohedral Symmetry. H. Ungemach. *Zeits. f. Krist.* 91. *pp.* 97–113, *Aug.*, 1935. *In French.*—Historical discussion, together with a number of examples illustrative of the title. The equation $a+c+d=3\,n$ (n integral) is dealt with in some detail. F. I. G. R.

4066. Structure of Layer-Lattices. W. Lotmar. *Zeits. f. Krist.* 91. *pp.* 187–191, *Aug.*, 1935.—An attempt is made to account, on structural grounds, for the broadening (or lack) of (hkl) interferences in layer-lattice structures, and the strong character of (hko) and (ool). Arnfelt has already suggested that the particles are like small discs which may be relatively displaced in the layer plane. The present proposal is that a " puckered " or wave-like arrangement is actually present, which accords with the observed plasticity of some layer-lattice crystals. Finally, it is pointed out that both this effect, and Arnfeld's may function together.

F. I. G. R.

4067. Matrix-Algebraic Development of Crystallographic Groups. Part III. F. Seitz. *Zeits. f. Krist.* 91. *pp.* 336–366, *Sept.*, 1935. *In English.*—The theory of operators representing general space-movements of a rigid body is discussed from a matrix-algebraic standpoint, and the conditions to be satisfied by the groups of operators of crystallographic interest are developed ; on this basis the derivation of the space groups is begun and the generating elements of the groups are presented. (Groups C_{1-3}, C^{h}_{1-3}, C^{v}_{2-3}, D_3, D^{h}_3, S_2, V and V^h are dealt with.)

C. A. S.

4068. Relationships Between the Hexagonal Atomic Lattice and the Reciprocal Lattice in Quadrinomial Symbolisation. I. Schaacke. *Zeits. f. Krist.* 91. *pp.* 466–472, 1935.—In general, crystallographic and structural problems in the hexagonal system are solved partly by means of trinomial symbolisation and partly by quadrinomial. There are, however, particular lattice problems for whose treatment it is advantageous to use the direct relationships between the hexagonal atomic lattice with quadrinomial symbols and the reciprocal lattice with the same symbols, and in the present paper the relationships between these two symbolisations are described and discussed. A Bibliography is included. H. H. Ho.

4069. Solid Solutions with a Varying Number of Atoms in the Unit Cell. G. Hägg. *Zeits. f. Krist.* 91. *pp.* 114–122, *Aug.*, 1935. *In English.*—A discussion of the effect that the number of atoms in the unit cell of a solid solution is found to vary with composition. In general, the problem is that of " interstitial " solutions (akin to the structures characteristic of silicates). A rigid frame-work is necessary for neutral atoms or groups—such as provided by the transitional elements into a scaffolding of which can be placed small atoms like, H, B, C, N. Other classes of interstitial solutions are considered, together with the associated problem of valency and electrical conductivity. F. I. G. R.

4070. Structure of CdSb. A. Ölander. *Zeits. f. Krist.* 91. *pp.* 243–247, *Sept.*, 1935.—The structure of CdSb is determined from X-ray powder and rotation photographs. It is found to be orthorhombic with $a=8\cdot492$, $b=8\cdot320$, and $c=6\cdot390$ Å. There are 16 atoms in the unit cell and the symmetry of the space group is V_h, V or C_{2v}. J. T.

4071. Structure of Gallium. A. J. Bradley. *Zeits. f. Krist.* 91. *pp.* 302–316, *Sept.*, 1935. *In English.*—A redetermination of the crystal structure of metallic Ga by the X-ray powder method confirmed Laves' orthorhombic structure [see Abstract 1287 (1933)], but photographs with Ni Kα radiation showed that all three axes were different in length: $a=4\cdot5167 \pm 0\cdot0001$ Å; $b=4\cdot5107 \pm 0\cdot0001$ Å; $c=7\cdot6448 \pm 0\cdot0002$ Å. The axial ratios are $a:b:c = 1:0\cdot99868:1\cdot69257$. The space-group is V_h^{18}. The values of m and p were obtained accurately by comparing the observed photometer measurements with artificial photometer curves in an original manner. AUTHOR.

4072. Structure of the Electrolytic Oxide Layer on Aluminium. E. J. W. Verwey. *Zeits. f. Krist.* 91. *pp.* 317–320, *Sept.*, 1935.—*In English.*—The structure of cubic γ'-Al_2O_3, formed by the electrolytic oxidation of Al, is described as an averaged structure of the kations. The unit cell contains 4 O-ions in face-centred positions; $2\frac{2}{3}$ Al^{3+} ions are distributed statistically over all the interstices between the O^{2-} ions in such a way that 70 % of the Al^{3+} have a coordination number 6 and 30 % a coordination number 4 with regard to the oxygen. γ'-Al_2O_3 and γ-Al_2O_3 are intermediate cases between the amorphous and the completely arranged state. AUTHOR.

4073. Nature of the Polished Layer of Metals. M. Miwa. *Tohoku Univ., Sci. Reports,* 24 *pp.* 222–239, *Sept.*, 1935. *In English.*—Regarding the nature of the polished layer of metals, there are two opinions; the one considers it to consist of an amorphous layer, while the other assumes it to be crystalline. In the present investigation, well polished surfaces of various metals were examined by means of kathode-ray diffraction, and it is shown that these surfaces, except in a few cases, may be considered to be amorphous. The surfaces were also examined at various stages of polishing, and the diffraction patterns characteristic of well polished surfaces were found to be satisfactorily explained by the latter theory. The duality of the nature of the polished surface arises from the fact that there is no sharp distinction between an amorphous state and a crystalline state in the ultimate limit and that the true nature of the polished surface lies between the two states. AUTHOR.

***4074. Structure of Metallic Coatings, Films and Surfaces.** *Faraday Soc., Trans.* 31. *pp.* 1045–1290, *Sept.*, 1935.—A symposium on the subject, arranged under two main headings, comprising 26 papers followed by general discussions of them by various contributors as follows:

"Introductory Paper," by **C. H. Desch** (*pp.* 1045–1048), contains a general account of the problems to be discussed in the detailed contributions.

Part I. Electron Diffraction Methods.

"Apparatus for Electron Diffraction at High Voltages," by **G. P. Thomson** (*pp.* 1049–1051).—A description is given of an electron tube and diffraction camera working between 45 and 85 kV, which employs the method of two-stage acceleration.

"Electron Diffraction and Surface Structure," by **G. I. Finch, A. G. Quarrell and H. Wilman** (*pp.* 1051–1080).—The present state of the technique of electron diffraction, covering production and interpretation of diffraction patterns, is outlined, and some applications of the method are illustrated by examples drawn from the study of metallic films and surfaces.

"Inner Potentials of Crystals and Electron Diffraction," by **W. E. Laschkarew** (*pp.* 1081–1095).—"Effective" potential is reviewed in relation to electron diffraction. By considering a simplified model, it is shown that the effective potential is not constant, but increases with the order of diffraction.

"Thickness of the Amorphous Layer on Polished Metals," by **H. G. Hopkins** (*pp.* 1095–1101).—Previous work on the nature of polish is summarised and the conclusions drawn from it are reviewed. New experiments on polished and spluttered gold surfaces show that the thickness of the Beilby layer produced as described is about 30 Å over much of the surface, and that there is a gradual increase in crystal size below the polished surface.

"Structure of Polished Metal Surfaces," by **C. S. Lees** (*pp.* 1102–1106).—In electrolytically-etched polished copper and gold surfaces, the Beilby layer is found to be separated from the non-orientated polycrystalline interior by a layer of orientated crystals, the thicknesses of the two layers being found.

"Molecular Layers of Fatty Substances on Metals," by **J. J. Trillat** and **H. Motz** (*pp.* 1127–1135).—Experiments with layers of fatty substances on gold films suggest that on the surfaces of metals there are almost always very thin layers of such substances, principally paraffins or waxes. When these layers spread on the surfaces, they crystallise perfectly, giving rise to very intense electron diffraction patterns.

Part II. Structure of Metallic Coatings.

"Crystallisation of Thin Metal Films," by **E. N. da C. Andrade** (*pp.* 1137–1143).—The processes occurring during the crystallisation of thin gold and silver films heated to various temperatures, as seen under the polarisation microscope, are described in detail and interpreted.

"Validity of Drude's Optical Method of Investigating Transparent Films on Metals," by **L. Tronstad** (*pp.* 1151–1158).—Drude's optical method for the examination of thin transparent films is reviewed, and the validity and applicability of the method for a wide range of surface problems are discussed.

"Optical Research on Evaporated Metal Layers," by **L. S. Ornstein** (*pp.* 1158–1166).—Optical methods for investigation of transparent metal films are described. They depend respectively on measurements of transmissibility and of reflectivity. Applications are mentioned.

"Determination of the Structure of Electrodeposits by Metallurgical Methods," by **D. J. Macnaughtan** and **A. W. Hothersall** (*pp.* 1168–1177).—The importance of the use of ordinary metallurgical methods in investigating the structure of electrodeposited metals is shown, and the use of some such tests and the results obtained are described.

"Chemical and Physical Properties of Electrodeposited Metals in Relation to their Structure," by **M. Schlötter** (*pp.* 1177–1181).—Experiments are described which show that the chemical and physical properties of electrodeposited metals are changed by the entry of anions into the crystal lattice of the kathodic deposit.

"Somatoid Elements of Structure in Electrolytic Metal Deposits," by **V. Kohlschütter** (*pp.* 1181–1188).—A general account of somatoids and their formation, with particular reference to their production during electrodeposition.

"Effects of Film Formation on the Structure of Electrodeposited Metallic Coatings," by **E. Liebreich** (*pp.* 1188–1194).—Chemical reactions which may take place at the kathode during electrolysis of various materials are described, and the effects of the formation of films on the kathode on the nature of the deposited coating are discussed.

"Kathodic Film in the Electrolytic Reduction of Aqueous Chromic Acid Solutions," by **E. Müller** (*pp.* 1194–1203).—The relationship between current density and voltage during electrolysis of pure aqueous chromic acid solutions and solutions of chromic acid containing K_2SO_4 is investigated by an oscillograph method. The results are discussed in the light of the existence on the kathode in the case of the pure solution of a film of chromium chromate, and the breaking down of this film by the SO_4 ion.

"Structure and Properties of Nickel Deposited at High Current Densities," by **W. Blum** and **C. Kasper** (*pp.* 1203–1211).—Experiments on the deposition of nickel at current densities of at least 20 A/dm.^{2} are described.

"Influence of the Support or Kathode on the Structure of Electrolytic Deposits Obtained in Aqueous Solution," by **A. M. Portevin** and **M. Cymboliste** (*pp.* 1211–1218).—The fine structure of electrodeposits is influenced by the fine structure (number of crystals per unit surface) of the kathode, by the concentration of the contact electrolyte, by the current density and by the temperature. These effects are investigated.

"Electrode Potentials and the Form of Electrodeposited Metals," by **S. Glasstone** (*pp.* 1232–1237).—Analysis of this problem shows that there must be some connection between the form of the electrodeposited metal and the electrode potential operative during its production, but it is only rarely possible to determine the exact relationship. The fundamental connection may be obscured by incidental factors.

"Factors Affecting the Structure and Grain Size of Electrodeposited Cadmium," by **S. Wernick** (*pp.* 1237–1242).—Investigations of the effect of electrolyte composition and conditions of electrolysis on the grain size of cadmium deposited from cyanide and from sulphate baths are described.

"Influence of the Basis Metal on the Structure of Electrodeposits," by **A. W. Hothersall** (*pp.* 1242–1247).—The effect of changing the basis metal on the structure of electrodeposits under otherwise fixed conditions (giving fairly large grain size) is studied with Cu, Ni or Sn deposits on various types of Cu, Cu-Zn alloys, Ni, Fe, Sn, Sn-Sb alloy, and Ag kathodes; and the conditions under which the structure of the basis metal is continued in the deposit are investigated.

"Differences in the Structure of Electrodeposited Metallic Coatings Shown by X-Ray Diffraction," by **W. A. Wood** (*pp.* 1248–1253).—The differences in the X-ray spectra of an electrodeposited metal coating and of the normal metal are discussed, and relations between the selective orientation and brightness of Ni and Cr coatings are noted. Attention is drawn to the diffusion of the spectral lines of these coatings, and to a correspondence between line-broadening and the hardness of the deposits.

"Structure of Electrolytic Chromium," by **L. Wright, H. Hirst** and **J. Riley** (*pp.* 1253–1259).—The existence of the hexagonal modification of Cr in deposits obtained from chromic acid solutions has been confirmed, and an account is given of its characteristics and of the conditions under which the hexagonal and the body-centred cubic form are produced.

"Determination of Phase Structure of Metallic Protective Coatings by Anodic Dissolution," by **A. Glazunov** (*pp.* 1262–1268).—In cases where the base metal is protected at the expense of the coating, the method of anodic dissolution serves to test not only the thickness of the whole coating or of the intermediate layer, but also to ascertain what phases compose this layer and to determine their thickness. It can also be used to ascertain the method used in the coating process.

" Improvement of the Quality of Sprayed Metallic Coatings by the Use of Non-Metallic Intermediaries and Supports," by **H. Reininger** (*pp.* 1268–1276).—The mechanical properties of ordinary sprayed coatings are compared with those of the same coatings after impregnation with varnishes. A number of points (increase in strength and adhesion to base; higher deformability; grinding; resistance to corrosion) in which the varnished coatings proved to be superior to ordinary ones are described and explanations of the effects are sought.

" Factors Influencing the Formation and Structure of Hot-Dipped Tin Coatings," by **E. J. Daniels** (*pp.* 1277–1285).—Existing theories of the factors involved in the formation of hot-dipped coatings are reviewed, and an account is given of various effects which influence the structure of the coatings.

" Concluding Remarks," by **C. H. Desch** (*pp.* 1288–1290), provide a general review of the discussion and summary of the chief conclusions reached. C. B. A.

4075. Effect of Thermal Agitation on Atomic Arrangement in Alloys. Part II. W. L. Bragg and E. J. Williams. *Roy. Soc., Proc.* 151*A. pp.* 540–566, *Oct.* 1, 1935.—The treatment given in a previous paper [see Abstract 3107 (1934)] of the order-disorder transformation in alloys, and a recent more rigorous analysis along similar lines by Bethe, is compared with the formal treatments of Borelius, Gorsky, and Dehlinger. Measurements of specific heat by Sykes make it possible to estimate the changes in internal energy due to the transformatiion in the alloys CuZn and Cu_3Au. These measurements are compared with the results of theory. Expressions are given for the dependence of critical temperature upon composition. AUTHORS.

4076. Structure of Heteropolyacids and their Salts. Part I. Tungstosilicic Acid, Tungstoboric Acid and Ammonium Tungstoborate. O. Kraus. *Zeits. f. Krist.* 91. 5–6. *pp.* 402–409, 1935.—12-tungstosilicic acid (I), 12-tungstoboric acid (II) and NH_4 12-tungstoborate (III) are isomorphous, with *a* 12·98, 12·83 and 12·80 Å; *c* 18·52, 18·38 and 18·52; density 3·70, 3·78 and 3·76 respectively: all have two molecules in the unit cell, space group D_{4h}^6. It is suggested in explanation of the isomorphism of I and II that II is $H_5BW_{12}O_{40} \cdot 31H_2O$ (instead of $B_2O_3 \cdot 24WO_3 \cdot 66H_2O$) in agreement with $H_4SiW_{12}O_{40} \cdot 31H_2O$ for I, and $(NH_4)_5BW_{12}O_{40} \cdot 26H_2O$ for III, the ionic radii of B^{III} and Si^{IV} being closely similar and coordination numbers identical; in that of II and III that II is really $(OH_3)_5BW_{12}O_{40} \cdot 26H_2O$, the hydroxonium and $NH^+{}_4$ ions being equivalent. C. A. S.

4077. Structure of Sodium Uranyl Acetate. I. Fankuchen. *Zeits. f. Krist.* 91. 5–6. *pp.* 473–479, 1935. *In English.*—Sodium uranyl acetate is cubic, space group $T^4(P2_13)$. The cell size is 10·670 ± ·001 Å. There are four molecules in the unit cell. The uranium is accurately located. On a basis of packing considerations, the acetate groups were located approximately. The sodium was located at a point suggested both by X-ray evidence and packing considerations. AUTHOR.

4078. Structures of Hydrated Compounds. Part II. Structure Type $Mg(ClO_4)_2 \cdot 6H_2O$. C. D. West. *Zeits. f. Krist.* 91. 5–6. *pp.* 480–493, 1935. *In English.*—A survey is given of the crystal character of hydrated perchlorates and fluoborates of some univalent and divalent metals, Li, Na, Ag, Mg, Mn, Fe, Co, Ni, Cu, Zn, Cd, Hg. The structure of the $Mg(ClO_4)_2 \cdot 6H_2O$ type, including twelve isomorphous hydrates of Mg, Mn, Fe, Co, Ni, Zn, as found by analysis of X-ray data, is detailed. It is derived from the hexagonal structure of Li $ClO_4 \cdot 3H_2O$ by removing half of the Li atoms from octahedral positions and replacing the remainder with Mg. The twinning of the crystals was such as to obscure the symmetry and dimensions of the true structure unit, which only became apparent after the complete structure had been found, and has the feature that the water perchlorate lattice is continuous by virtue of its high true symmetry; the metal lattice, having a lower symmetry, is alone discontinuous at the twinning boundaries. [For Part I see Abstract 2707 (1934).] AUTHOR.

4079. Relation between the Alum Structures. H. Lipson. *Roy. Soc., Proc.* 151*A*. *pp*. 347–356, *Sept*. 2, 1935.—The existence of three alum structures is demonstrated, and the parameters of rubidium alum, α structure, cæsium alum, β, and sodium alum, γ, are derived. From the variation of these parameters, an attempt is made to explain the reasons for the existence of the three structures, and to show the relation between the α and β structures. The γ structure does not appear to be directly related to the other two, but exists merely as an alternative way of fitting together the various groups while maintaining the dispositions of bonds round the water molecules. AUTHOR.

4080. Electronic Structure of Diamond. G. E. Kimball. *J. Chem. Phys*. 3. *pp*. 560–564, *Sept*., 1935.—The method of Wigner, Seitz and Slater has been applied to the determination of the electronic structure of diamond. It is found that the energy levels of the carbon atom are broadened into bands similar to the energy bands in metals. The 2*s* level of the atom splits into two bands, and the 2*p* level into six bands. The two 2*s* bands are completely filled by electrons and the two lowest of the 2*p* bands. The lowest unfilled band has a much higher energy than the highest filled band. The lack of electrical conductivity is explained and other properties of the diamond are discussed. AUTHOR.

4081. X-Ray Examination of Methylene Blue. W. H. Taylor. *Zeits. f. Krist*. 91. 5/6. *pp*. 450–465, 1935. *In English*.—The methylene blue sulphur chloride, bromide, and iodide, and selenium bromide, have been examined optically and by X-ray methods for their structural determination. The iodide exists in two different triclinic forms, one of which occurs in single crystals the other as interpenetration twins, while the sulphur chloride and bromide and the selenium bromide form a group of isomorphous monoclinic crystals which are invariably interpenetration twins. The optical properties, the cell dimensions and space groups, and the nature of the twinnings are described in the first part of the paper. The relationship between one form of the iodide and the monoclinic crystals shows how the existence of certain very strong reflections in all these crystals must be interpreted in terms of the positions taken up by lath-shaped molecules of the type indicated by the chemical constitution. A special feature of the intensities of reflection from the iodide, due to the large scattering power of the iodine atoms, permits the location of these atoms, and a structure is suggested for the crystal wherein the lath-shaped molecules are stacked one above the other and packed end to end, adjacent stacks being separated by layers containing I atoms and water molecules. All the I atoms have similar environments, with CH_3 groups as nearest neighbours. There is no sharp distinction between the two ends of the

C-N-S chain, and the I does not appear to be bound to one particular atom of this chain but rather to be acting simply as one unit of packing in the structure. No conclusions could be drawn with regard to the environment of the halogens in the monoclinic crystals, but the invariable twin growth is explicable on the assumption that the C-N-S chains are stacked as in the iodide. H. H. Ho.

4082. Orientation Effect of Electric Fields on the Molecules of Anisotropic Liquids. W. Fréedericksz and V. Cvetkov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 528–534, *June*, 1935. *In German.*—Two methods are available to show the orientation of the molecule in an anisotropic liquid due to the influence of an electrical field. In both cases the movement of the fluid or liquid must be avoided and only the molecular movement observed. The first depends upon the use of h.f. fields and the second by obtaining the liquid in very thin layers so that no movement can exist. The latter method is considered and the former is used as confirmatory. After theoretical discussion 3 different liquids were investigated, namely, p-azoxyanisol, p-acetoxybenzaline, and dibenzalbenzidin, using an electrical field of frequency 10^3. The method involved the use of a film thinner than the critical thickness and this was secured by compression between glass surfaces. Thus the movement possible for the liquid is so small that any effect observed must be attributed to the molecular orientation. The present values are in good agreement with those of Foex and Royer. With a frequency of 10^3 and $3 \times 10^5 \ll \nu \ll 6 \times 10^5$ the effect of the electric field is shown as proportional to the square of the field potential and thereby the orientation of the liquid must be considered as a result of the dielectric anisotropy. In dibenzalbenzidin where the molecule is symmetrical, it is orientated in an electric field parallel thereto, contrary to the Zocher rule. With regard to the polarisation the greatest values are found in the directions of the optical axes of the molecule, which the positive character of the double refraction does not contradict, affording analogous phenomena also for the ethoxy-benzal-amino-α-methyl-cinnamic acid ethyl ester, established previously by Kast and Dorn. S. G. B.

4083. Nature of Recrystallisation Processes. Parts I-III. H. G. Müller. *Zeits. f. Physik*, 96. 5–6. *pp.* 279–327, *Aug.* 31, 1935.—Part I investigates single grain recrystallisation of formed single crystals for the case of rock-salt over the temperature-range of 270°–790° C. It is established that the temperature law of the average velocity of the invisible nuclear growth, as well as the time-independent velocity of the visible growth is given by the two-termed van't Hoff formula, $v = A_1 \cdot e^{-B_1/T} + A_2 \cdot e^{-B_2/T}$, so that fundamentally nuclear formation and growth are possible at all temperatures. Special embryonic formation does not take place at recrystallisation, and the nuclear position can be injured by thermal relaxation or by foreign atoms. The regularity of the nuclear growth agrees in general with that of ordinary crystal growth. Part II investigates the recrystallisation of single crystals. Rock-salt when recrystallised from the compressed powder exhibits microscopic and ultramicroscopic defects which have been confirmed by accurate density determinations. The microscopic anomalous formation of recrystallised products has been further established by photochemical means and mechanical tests. Part III extends the investigation of rock-salt which has been compressed. The breaking strength of tempered rock-salt shows qualitatively the same dependence on glow temperature and duration of temper as do compressed metals. The observed nuclear coarseness of grain does not depend on recrystallisation through new nuclear formation, but the possibility arises that the velocity of granular increase and the velocity of visible growth of the recrystallisation grains run parallel. H. H. Ho.

4084. Crystal Growth of Alkali Halides. Z. Gyulai. *Zeits. f. Krist.* 91. *pp.* 142–153, *Aug.*, 1935.—A detailed account with illustrations is given of the growth of crystals of NaCl and KCl from solution in H_2O or H_2O and EtOH, from vapour, and from the molten salt. The results are in accordance with the Kossel-Stranski theory [see Abstracts 40 (1929) and 953 (1935)]. C. A. S.

4085. Habit Modification of $KClO_4$ Crystals. H. E. Buckley. *Zeits. f. Krist.* 91. 5/6. *pp.* 375–401, 1935. *In English.*—The effect on the habit of the presence of 0·005–15·0 % of 71 different dyes in crystals of $KClO_4$ has been examined. In general (though with some unexplained exceptions, but probably connected with the molecular constitution of the dye) with similar concentrations dyes with small molecules cause a predominance of the {011} faces, with large of {102}. Increasing concentration increases the predominance of {102}, probably through association giving rise to larger molecules ; when through association or otherwise the dye is colloidal there is a tendency towards dendrites. On the average similar effects are produced by half as much dye in K_2SO_4 and by 1/9th in $KClO_3$. In $KClO_4$ a new cleavage parallel to 100 is developed by methyl orange. The effect of inorganic ions is very similar to that of such on $KMnO_4$ save that {110} is never modified [see Abstract 1101 (1934)]. All natural developments of $BaSO_4$ have now been artificially imitated by $KClO_4$ or $KMnO_4$. C. A. S.

4086. Producing Single Crystals of Aluminium. V. H. Stott. *Faraday Soc., Trans.* 31. *pp.* 998–1000, *Aug.*, 1935.—Various modifications—especially as regards the precise method of rolling the metal bars used—in Carpenter and Elam's method of producing single crystals of aluminium [see Abstract 1029 (1922)]. The procedure adopted in preparing single crystals containing a transverse cylindrical hole is also described. T. H. P.

4087. Determination of X-Ray Intensity by Means of Other Physical Data. A. Hettich. *Zeits. f. Krist.* 91. *pp.* 154–156, *Aug.*, 1935.—A relation is deduced between the structure-amplitude and density distribution from which the phase angle has been eliminated. The scattering power of a crystal thus determined depends only on the density of packing, and is independent of the structural arrangement. It is also shown how the total X-ray intensity can be determined without individual intensity measurements [see Abstract 564 (1935)]. C. A. S.

4088. Application of Plane Groups to Interpretation of Weissenberg Photographs. M. J. Buerger. *Zeits. f. Krist.* 91. *pp.* 255–289, *Sept.*, 1935. *In English.*—A Weissenberg photograph being a projection of a single plane of the reciprocal lattice, all possible patterns can be predicted by a study of the plane point-groups and translations. Tables are given for determining the centrosymmetrical class of the crystal investigated. Combination of each of the 10 plane point-groups with 2 translations gives the 15 possible distinct position patterns, criteria for the recognition of which are given. Geometrical and visual methods follow for determining unit cell type and dimensions and the space group without analytical procedure or indexing reflections. A new notation is suggested and exemplified for triclinic and monoclinic crystals. [See also Abstract 1380 (1935).] C. A. S.

4089. Arithmetical View of Crystal Classes, and Deduction Thereby of Space Groups. P. Niggli and W. Nowacki. *Zeits. f. Krist.* 91. *pp.* 321–335, *Sept.*, 1935.—A classification of the 230 types of crystal structure based on Burckhardt's "arithmetical (*a*)" method combined with Fedoroff's "geometrical (*g*)" method, leading to their distribution into 73 *a*-classes, and then as symmorphous (73), hemisymmorphous (54) and asymmorphous (92 + 11). The 73 *a*-classes are then classified according to their syngony and hyposyngony, and illustrations drawn from the mica, feldspar and olivine groups. C. A. S.

4090. Back-Reflection Laue Method for Determining Crystal Orientation. A. B. Greninger. *Zeits. f. Krist.* 91. *pp.* 424–432, 1935.—The method consists essentially in passing a collimated beam of white X-radiation through a hole in the film on to the crystal, whence it is diffracted back on to the film; each important plane selects the correct wave-length and gives a diffraction spot. The method for identifying these spots is detailed and a hyperbolic coordinate plat to facilitate this is given. [See Abstract 4058 (1932).] C. A. S.

See also Abstracts 4128, 4208, 4211, 4233, 4239, 4301, 4305, 4309, 4322, 4359, 4367, 4370, 4395, 4396, 4397.

DENSITY.

4091. Critical Constants of Unassociated Substances. A. Ferguson and S. J. Kennedy. *Faraday Soc., Trans.* 31. *pp.* 1000–1003, *Aug.*, 1935.—From the formula recently developed [see Abstract 927 (1934)], the equation $\rho=2\rho_c[0\cdot91(1-m)^{0\cdot3}+(1-0\cdot5m)]$ is derived as a working equation for the critical density of non-associated liquids, ρ being the orthobaric density at a reduced temperature m. This gives $\rho = 3\cdot82\,\rho_c$ for the zero density of the supercooled liquid. The expression $\rho_b T_b = 0\cdot0823\ \mathrm{M}p_c$ allows the critical pressure to be calculated from the *b.p.* and the density at the *b.p.* If ρ is the density at a temperature $T = 0\cdot6 \times$ (absolute critical temperature), $\rho T = 0\cdot07804\ \mathrm{M}p_c$ gives p_c. Values of p_c and ρ_c calculated as above show good agreement with observed values. T. H. P.

See also Abstract 4366.

DIFFUSION AND OSMOSIS.

4092. Diffusion of Hydrogen and of Deuterium into Palladium. Part I. W. Jost and A. Widmann. *Zeits. f. phys. Chem.* 29. *Abt.B.* 4. *pp.* 247–255, 1935.—Experiments made with a sphere of palladium coated with palladium-black give, for the temperature range 192–302·5° C., the expression $D = 5\cdot95 \times 10^{-3} \times e^{-5720/RT}$ cm.^{2} sec.$^{-1}$, for the velocity of diffusion of hydrogen into palladium. At 302·5°, the velocity for deuterium bears to that for hydrogen the ratio 1 : 1·35. Within the limits of experimental error, this is 1 : $\sqrt{2}$, the ratio of the thermal velocities of deuterium and hydrogen. T. H. P.

4093. Osmotic Pressure of Mixed Vapour. Berkeley (Earl of). *Phil. Mag.* 20. *pp.* 481–504, *Sept.*, 1935.—The equations previously deduced [see Abstracts 1539 (1908) and 1471 (1909)] connecting the osmotic and vapour pressures of two volatile components and the hydrostatic pressure requires a knowledge of the pressures of the pure vapours which are in osmotic equilibrium with the mixed vapour. Methods

depending on thermodynamic cycles for doing this, and for calculating the concentrations at any height of the components are given, as also a general equation connecting the vapour pressures. Lastly two methods for determining the osmotic pressures of the solutions are described.
C. A. S.

See also Abstracts 4126, 4375.

ELASTICITY AND PLASTICITY.

4094. Mechanical Significance of Airy's Function. L. Sobrero. *Ricerche di Ingegneria*, 3. *pp*. 77–80, *May–June*, 1935.—In a continuous plane elastic system, in which the external forces act only at isolated points of its boundary, a curve C is drawn joining a fixed point P_0 to any point P of the system. The moment round P of the internal forces exerted by the matter on the left of C upon the matter on the right of C does not depend on the particular curve C but only on its extremities, and coincides with Airy's function calculated for the point P. The author makes use of this mechanical interpretation of Airy's function to extend the definition of that function to the case of plane discontinuous systems. A. J. McC.

4095. Principle of Virtual Work Applied to the Determination of Critical Loads. O. Zanaboni. *Ricerche di Ingegneria*, 3. *pp*. 80–91, *May–June*, 1935.—It is shown how a structure in a state of indeterminate equilibrium (under the action of critical loads) leads to an equation of virtual values of the second order, in every way analogous to the ordinary equation of virtual work. From this equation can be deduced approximate methods (with an unlimited degree of approximation) for the practical determination of the critical loads, and it is shown that the methods already used for this purpose appear as particular cases of the present method. Several examples are treated in detail. A. J. McC.

4096. Plastic Properties of AgCl and NaCl. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion*, 8. 1. *pp*. 25–40, 1935. *In German*.—Experiments on the plastic properties of single crystals of AgCl and NaCl support the view that the mechanical properties of a crystal are closely connected with the polarising properties of its components. J. T.

***4097. Extensometer Comparator. A. H. Stang and L. R. Sweetman.** *Bureau of Standards, J. of Research*, 15. *pp*. 199–203, *Sept*., 1935.—An extensometer comparator for the calibration of extensometers, compressometers, micrometer dials, and strain gauges is described. The comparator has given satisfactory results in calibrating length-measuring instruments used for testing materials. AUTHORS.

See also Abstracts 4121, 4163, 4232.

GRAVITATION.

***4098. Static Gravimeter. H. Haalck.** *Beitr. z. angew. Geophys*. 5. *pp*. 152–168, 1935.—The author describes in detail his static gravimeter, based on a barometric principle, for measuring the force of gravity with an accuracy comparable with that obtainable by means of pendulum measurements, and in a time very small compared with such measurements. The principle employed in the gravimeter is the differential pressure exerted by two masses of gas located at different heights at the end of a closed barometer tube filled with mercury. If p, v denote the pressure and volume of the upper mass, and p', v' those of the lower, then $p' - p = h\sigma g$, where h is the difference in height of the two ends of the connecting column of mercury, σ the density of the mercury, and g the value of gravity at the place. In order to determine g to an accuracy of 1 mgal., the height of the mercury column must be measured to a millionth part. The influence of temperature is counteracted by enclosing the apparatus in ice, maintained at 0° C. very nearly. The height is measured by employing a hydraulic magnifying device so arranged that a variation of 1 mm. in the height of a meniscus represents a variation in the value of g of about 1 mgal. A single measurement at a station can be made in 10 min. The accuracy can be improved by repetition to attain 0·5 mgal. Examples of a few test surveys are given, and the advantages of the apparatus for making fairly detailed gravity surveys over large areas at relatively small cost are outlined. The surveys may have either a purely geophysical or an economic geological aim. The gravimeter provides a valuable reconnaissance instrument for geological surveys of which the objective is to trace the course of large buried structures, details of which may be filled in later by using the torsion balance. E. L. J.

HYDRODYNAMICS AND AERODYNAMICS.

4099. Vortex Polygons. W. B. Morton. *Roy. Irish Acad., Proc.* 42*A*. *pp*. 21–29, *April*, 1935.—The classical work of J. J. Thomson on Motion of Vortex Rings is revised and completed. In a previous paper [see Abstract 4426 (1934)] the author has examined the oscillations about steady motion of vortices arranged in certain geometrical configurations. For the pentagonal and hexagonal configurations one of the oscillation periods found by Thomson was less than the period of rotation of the equal vortices. It is now shown that these shorter periods are spurious, being the result of an unjustifiable step in the analysis. Further, the small imaginary value found for a frequency in the case of 7 vortices should be replaced by zero, so that this configuration is on the borderline of stability to the first order of small disturbances. The heptagon can, however, be distorted into a stable form to this degree of approximation. This probably signifies effective instability if the approximation were carried further. For 8 or more vortices the steady motion is definitely unstable. The modes of oscillations of the various systems are analysed. J. S. G. T.

4100. Water Bells. E. Buchwald and H. König. *Ann. d. Physik*, 23. 6. *pp*. 557–569, *Aug*., 1935.—Water bells are formed when a perpendicular water-jet impinges centrally upon a horizontal disc, and measurements are now recorded of the meridian curves, water discharge per sec., and thickness of such bells. The microscopic method of Chaulnes and that based on the absorption of infra-red radiation have been utilised. By means of the data, Boussinesq's theory has been employed to determine anew the dynamical surface tension of the water, which lies about 10 % above the statical value, *i.e.*, at 81·5 dyne/cm. at 12° C., as compared with 74 dyne/cm. Lenard's views with respect to the tension of fresh surfaces indicate, as a possible though not complete explanation, the formation of an electrical double layer in the water surface. It is also probable that the simple water molecules have not sufficiently displaced the complexes from the surface. H. H. Ho.

4101. Statistical Theory of Turbulence. G. I. Taylor. *Roy. Soc., Proc.* 151*A*. *pp*. 421–478, *Sept*. 2, 1935.—In Part I an attempt is made to put the conception of mixing distance on a more rigorous basis. Correlation in the turbulent field is described in both the Eulerian and

Lagrangian manners. This results in the introduction of two lengths l_1 and l_2, related to the mesh length of the turbulence-producing screen. The rate of dissipation of energy is considered for isotropic turbulence. The " Eulerian theory " also contains a definition of λ, " the average size of the small eddies," which are responsible for the dissipation of energy by viscosity. The connection between this dissipation and the R_y correlation curve is predicted. In Part II the experimental measurements of Simmons and Salter and those of Dryden, behind grids and honeycombs, are reviewed. In Part III the distribution of dissipation of energy in a pipe over its cross-section is considered. It is shown that in the region near the walls turbulent energy is produced more rapidly than it is dissipated, whereas in the central region the reverse is the case. In Part IV the diffusion in a turbulent air stream is investigated. Use is made of the experimental results obtained by Schubauer for the spread of heat from a heated wire in a wind tunnel and of certain results from the N.P.L. These measurements give a length λ_η, a measure of the " smallest size of eddy." Theoretical relations for λ_η are deduced. Completely developed turbulent motion is contemplated throughout. G. F. P. T.

4102. Distribution of Velocity and Temperature Between Concentric Rotating Cylinders. G. I. Taylor. *Roy. Soc., Proc.* 151*A*. *pp*. 494–512, *Oct*. 1, 1935.—The distribution of velocity in water contained between concentric cylinders when the inner cylinder is rotated was measured by means of a Pitot tube. If U represents the velocity and r the radius, it was found that $Ur =$ constant to within $0{\cdot}4\ \%$ over $83\ \%$ of the annular space between the cylinders. In another experiment the rotating inner cylinder was maintained at a higher temperature than the outer one. The distribution of temperature in the air between the cylinders was measured and was found to decrease continuously outwards. According to the momentum transport theory of turbulent flow the distribution of temperature should be identical with the distribution of Ur. It is concluded that the momentum transport theory could account for the distribution of velocity near the solid surfaces but cannot explain the distribution through the main volume of the annular space between the cylinders. The vorticity transport theory can account for the distribution of velocity in the region where Ur is constant, but cannot for the distribution near the solid surfaces. AUTHOR.

4103. Humidity Effects with Hot-Wire Measurements. W. Paeschke. *Phys. Zeits*. 36. *pp*. 564–565, *Aug*. 15, 1935.—This paper records a humidity phenomenon observed during the measurement of wind velocity by a hot-wire method based on the determination of thermal loss which an electrically-heated metal wire (Pt-Ir) suffers in a current of air. Experimental details are included with data which show a dependence of the thermal current upon the moisture content of the air. This humidity effect cannot be calculated by a simple thermal conductivity mixture rule. H. H. Ho.

4104. Experimental Investigation on Air Resistance. S. Luthander and A. Rydberg. *Phys. Zeits*. 36. *pp*. 552–558, *Aug*. 15, 1935.—The flow of air about bodies of various shapes rotating about an axis parallel to the air stream is discussed. Experimental investigations on the flow round a rotating sphere are described. The amount of air resistance is determined. A qualitative investigation is carried out on the appearance of the stream form for different converging and rotating velocities. Photographs of the stream absorption are given and theoretical conclusions about the turbulent flow are reached. G. F. P. T.

4105. Quadratic Wave Equation. Flood Waves in a Channel with Quadratic Friction. M. A. Biot. *Nat. Acad. Sci., Proc.* **21.** *pp.* **436–443,** *July,* 1935.—An exact solution of the equation of propagation of waves with quadratic damping is obtained. It is shown that high amplitude waves are more quickly damped. The dependence of this damping effect on both the volume of the wave and the friction coefficient of the channel is discussed. The solution is interpreted physically as representing certain types of flood waves. G. F. P. T.

See also Abstracts 4162, 4164, 4174, 4175.

KINETIC THEORY OF MATTER.

4106. Kinetic Theory of Gases. Part I. Sound Absorption. Part II. General Equations of Motion and of Thermal Conductivity. K. F. Herzfeld. *Ann. d. Physik,* 23. 5. *pp.* 465–492, *Aug.*, 1935.—Herzfeld and Rice [see Abstract 2157 (1928)] recognised that the absorption of sound waves in gases could result from the slow rate of exchange of energy between the translational movement and the internal degrees of freedom of the molecule, in addition to the earlier accepted effects of viscosity and heat conduction. Recent work has shown that the two latter effects do not completely explain absorption measurements in the monatomic gas He. A mathematical analysis is now made to ascertain if this can be explained by deviations from the gas equation. Solutions for the macroscopic movement in gases in one direction are obtained to a higher order of approximation than previously, but the correction terms derived are probably too small to explain the experimental results. In the second paper solutions of the hydrodynamical equations are extended to three dimensions for the cases of viscosity and thermal conductivity. Calculations are made of the slip and temperature discontinuity at the boundary wall. A mathematical difficulty arises as to whether or not the velocity and temperature gradients remain linear to the wall. In the former case the formulæ are very complex, but for the latter case Enskog's formulæ permit the two effects to be accurately calculated. R. W. P.

4107. New Kinetic Theory of Gases. I. I. Rabi. *Rev. Sci. Instruments,* 6. *pp.* 251–253, *Sept.*, 1935.—The author discusses the difference in the effective collision cross-section on the classical hard sphere theory and in the wave-mechanical picture. The relation of the mean free path to temperature as well as density is well represented in the latter case without *ad hoc* assumptions. The theoretical results are directly verifiable by the method of molecular beams. Results for the mean free paths of the alkali atoms in various gases are given; the effective collision radii calculated from these data are much larger than on the classical theory; but the total cross-section always remains finite. T. L. M.

See also Abstracts 4075, 4380.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 4097.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

See Abstract 4406.

MECHANICS, CLASSICAL.

See Abstracts 4108, 4113, 4114.

MECHANICS, QUANTUM.

4108. Quantum Analogue of a Theorem of Poisson in Classical Dynamics. D. S. Kothari. *Acad. Sci. Proc., U.P. India,* 4. 1. *pp.* 71–72, *Aug.,* 1934.—A quantum mechanical proof is given of the following classical theorem of Poisson : if ϕ and ψ are two integrals of a dynamical system, then the Poisson-bracket $[\phi, \psi]$ is constant throughout the motion, *i.e.*, the equation, $[\phi, \psi]$ = constant, constitutes a new integral of the system. The theorem is illustrated by taking the components of angular momentum M_x and M_y as constants of the motion. N. M. B.

4109. Relations of Commutation in Quantum Electrodynamics. G. Wataghin. *N. Cimento,* 12. *pp.* 290–293, *May,* 1935.—A general formula is obtained of the relation of commutation among the operator-amplitudes ψ of the electron waves used in the application of quantum electrodynamics to the theory of Dirac's positron. H. M. B.

4110. Quantum Electrodynamics. P. Jordan. *Zeits. f. Physik,* 95. 3–4. *pp.* 202–209, *June* 4, 1935.—The possibility of eliminating all non-gauge-invariant magnitudes from the theory is established. The proof of a result given in a previous paper [see Abstract 2404 (1935)] is amplified. [See following Abstract.] W. S. S.

4111. Quantum Electrodynamics. Part II. Theory of Production of Pairs. P. Jordan. *Zeits. f. Physik,* 96. 3–4. *pp.* 163–166, *Aug.* 22, 1935.—It is shown that, if, in the theories of pair-production by Fermi's and Bose's statistics respectively, only the standard invariants occur in the formulæ, then these are closely analogous to the results of Bethe-Heitler on the one side and to those of Pauli-Weisskopf on the other. [See preceding Abstract.] H. M. B.

4112. Conformal Wave Equation. O. Veblen. *Nat. Acad. Sci., Proc.* 21. *pp.* 484–487, *July,* 1935.—A differential equation in generalised 4-dimensional conformal geometry is deduced, which is somewhat analogous to the Dirac equation for the electron in classical relativity. N. M. B.

4113. Koenig's Theorem in Wave Mechanics. L. de Broglie and J. L. Destouches. *Comptes Rendus,* 201. *pp.* 369–371, *Aug.* 5, 1935. —The wave mechanical problem of the centre of gravity of a system of particles of given mass is examined, and it is shown that an expression can be deduced for the kinetic part of the Hamiltonian, in which the first term corresponds to the kinetic energy of the centre of gravity at which the total mass is assumed to be concentrated, and the second term to the total kinetic energy of the particles of the system in their motion relative to the centre of gravity. Koenig's theorem is thus shown to be valid in wave mechanics. N. M. B.

4114. Theory of the Centre of Gravity in Wave Mechanics and its Applications. J. L. Destouches. *J. de Physique et le Radium,* 6. *pp.* 329–335, *Aug.,* 1935.—In continuation of previous considerations [see Abstract 3537 (1934)] it is shown that in wave mechanics the centre of gravity acts approximately as a heavy particle, and that theorems are valid corresponding to those in classical mechanics. The Heisenberg uncertainty relation applies, but the position-motion uncertainty product is rather greater than for an isolated particle. As in classical mechanics a logically independent system of kinetics can be established introducing the theorems associated with the kinetic magnitudes of the centre of gravity. This can be done in two forms, an operational kinetics giving only the relations between operators, and a quantum kinetics giving the relations between the values of the various magnitudes. In certain cases the theorems of the centre of gravity can be extended to the Dirac mechanics, and results are applied to the de Broglie photon theory; the equation is shown to be that of the centre of gravity of the two constituents; the spin of the centre of gravity is the sum of the spins of the constituent particles. The atomic nucleus is considered, and an equation of motion is found for the proton, assuming complex structure. N. M. B.

4115. Theory of the Brillouin-Wentzel-Kramers Method. E. C. Kemble. *Phys. Rev.* 48. *pp.* 549–561, *Sept.* 15, 1935.—In order to put Zwaan's scheme for deriving the Kramers connection formulæ on a rigorous basis, differential equations are set up governing the variation in the coefficients used to fit a linear combination of the B.W.K. type approximation functions to an exact solution of Schrödinger's equation in one dimension. Approximate solutions of the differential equations are worked out which lend themselves to the setting up of the connection formulæ and give definite upper bounds to the errors involved in their use. The method is also used to set up the Sommerfeld phase integral quantum condition independently of the connection formulæ. An upper limit to the error in the energy is worked out. A similar treatment of the problem of the transmission of matter waves through rounded potential barriers is formulated. AUTHOR.

See also Abstracts 4049, 4107, 4121, 4146, 4147, 4253, 4254, 4301, 4379, 4401, 4402.

RELATIVITY AND ETHER.

4116. Mathematical Theory of a New Relativity. S. H. Sulaiman. *Acad. Sci. Proc., U.P. India,* 4. 1. *pp.* 1–35, *Aug.*, 1934, *and* 4. 3. *pp.* 217–262, *Feb.*, 1935.—The theory is based on the assumption that gravitation is propagated with a finite velocity and is due to the emission by matter of particles, called gravitons, not subject to gravitation, but capable of possessing momentum. The emission of gravitons is assumed to be influenced by the presence of matter in such a way that particles of matter attract each other according to the inverse square law. It is assumed also that the law of gravitation between moving bodies is different from that holding between bodies at rest. Hence, by a suitable adjustment of arbitrary constants, the displacement of the perihelion of Mercury and the deflection of light by the sun are accounted for. A further assumption, *viz.*, the emission of gravitons with different momenta in the forward and backward directions by a moving body, together with the assumption that the frequency of light decreases as it passes through space, yields a theory of the expanding universe. No general principle connects these various assumptions, nor is any evidence for their separate plausibility put forward. G. C. McV.

4117. New Synthesis of World Geometry. C. Lanczos. *Zeits. f. Physik,* 96. 1–2. *pp.* 76–106, *July* 25, 1935.—The Hamiltonian canonical transformation, introducing the conjugate impulse as a new series of dynamical variables is developed in connection with the theory of relativity. In addition to the fundamental metric tensor, $g_{\alpha\iota}$, a second conjugate tensor, $h_{\alpha\iota}$, the deformation tensor, is introduced. World events are then conceived as associated with interaction between these tensors. The two groups of canonical equation demonstrate, in unmistakable manner,

the duality of gravitational and electrical calculi; the gravitational is based upon the metric tensor, the electrical upon the deformation tensor. The theory developed is to be considered as an elastic theory of the ether.
J. S. G. T.

4118. Energy Momentum Tensor and Velocity of Propagation of Waves. O. Halpern. *Phys. Rev.* 48. *pp.* 431–433, *Sept.*, 1, 1935.—It is shown that every wave phenomenon which is described by a symmetrical energy momentum tensor of the second order, propagates with the velocity of light, provided that the 4-dimensional divergence and the diagonal sum of the energy momentum vanish. This theorem is applied to the two different expressions given for the energy momentum tensor of electromagnetic phenomena in material bodies by Minkowski and Abraham.
AUTHOR.

4119. Dirac Electron in a Gravitational Field. O. Halpern and G. Heller. *Phys. Rev.* 48. *pp.* 434–438, *Sept.* 1, 1935.—In this paper the behaviour of Dirac's electron in gravitational fields is discussed for several special cases. In Paragraph II a general derivation of the red shift in a gravitational field is given without reference to the special atomic system concerned. Paragraph III contains a treatment of the gyromagnetic effect.
AUTHOR.

See also Abstracts 4136, 4379.

SOLUTION.

4120. Solubility of Hydrogen-Nitrogen Mixtures in Water. R. Wiebe and V. L. Gaddy. *Am. Chem. Soc., J.* 57. *pp.* 1487–1488, *Aug.*, 1935.—The solubility in water of an approximately 3:1 hydrogen-nitrogen mixture is determined at 25° and from 50 to 1000 atmospheres. It is found that the solubility of the mixture can be calculated within a few per cent from the values of the pure constituents. AUTHORS.

See also Abstracts 4125, 4126.

SURFACE TENSION AND COHESION.

4121. Quantum Mechanical Investigation of the Cohesive Forces of Metallic Copper. K. Fuchs. *Roy. Soc., Proc.* 151*A*. *pp.* 585–602, *Oct.* 1, 1935.—The energy of the 4*s* electrons in metallic copper is calculated by an extension of the method of Wigner and Seitz, taking into account the "exchange" energy between the 4*s* electron and the closed shells; the binding energy of the metal obtained is of the right order of magnitude, but in order to obtain the correct compressibility one must consider the interaction between the ions in the lattice due to the overlapping of the 3*d* shells with each other. This is calculated approximately by a statistical method. The reason for the face-centred structure of copper is discussed; it is shown that for copper the face-centred structure will have lower energy than the body-centred structure, but for sodium the calculation gives almost equal energies for the two structures. AUTHOR.

4122. Interfacial Tension. D. G. Dervichian. *Comptes Rendus*, 201. *pp.* 333–334, *July* 29, 1935.—The relation $\gamma_{AB} = \gamma'_A - \gamma_B$ is deduced from a consideration of the forces exerted in separating two liquids A and B at an interface, the liquids being such that the molecular forces between the two liquids exceed those in the liquid B. $\gamma'_A = \gamma_A - p$ where p is the reduction of surface tension of A due to the monomolecular layer of

B detached on A. Antonov's rule therefore holds for both miscible and non-miscible liquids, provided γ'_A is substituted for γ_A. Further consideration leads to an indication of the possibility of the existence of negative interfacial tension. P. H. B.

4123. Behaviour of Water Held in Fine-Pored Media. B. H. Wilsdon, D. R. G. Bonnell and (Miss) M. E. Nottage. *Faraday Soc., Trans.* 31. *pp.* 1304–1312, *Sept.*, 1935.—A primary consideration was to discover methods of examination which would be applicable at low water contents when the porous material might be described as no more than "damp." The methods applicable are discussed. It is shown that methods depending on the application of Kelvin's equation for the lowering of vapour pressure in capillaries do not lead to the same results as are obtained by the methods in which a hydrostatic tension is employed. The cause of these anomalous results and a possible explanation are discussed. H. H. Ho.

4124. Capillary Rise of Tars and Bitumens. A. Léauté. *Comptes Rendus*, 201. *pp.* 266–268, *July*, 1935.—It is stated that the surface tensions (6·5 to 7·8 mg./mm.) recently reported by the author for tars and bitumens [see Abstract 3329 (1935)] are in reality *twice* their surface tensions and should be halved. The paper deals mainly with the polishing, under traffic, of roads having a tar or bitumen base. It is suggested that this is due to the rise of the tar or bitumen under capillary action. P. H. B.

4125. Surface Tension and Solvation. H. G. Trieschmann. *Zeits. f. phys. Chem.* 29. *Abt.B.* 5. *pp.* 328–334, 1935.—On the basis of measurements of the surface tensions of mixtures of alcohols with various solvents, a molecular interpretation is given relating the phenomena of surface activity with the degree of solvation. The theory is tested against the available data. C. B. A.

See also Abstracts 4054, 4059, 4100, 4163.

VACUA, HIGH.

4126. Time Variation of Evolution of Gas from a Heated Wire in Vacuum. G. Euringer. *Zeits. f. Physik*, 96. 1–2. *pp.* 37–52, *July* 25, 1935.—The curves relating the emission of a gas from a nickel wire charged with hydrogen are found experimentally and the observed curves compared with those derived theoretically from considerations of the laws of diffusion. Comparison of the experimental and theoretical curves yield values for the solubility and diffusion coefficients of hydrogen in nickel. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

4127. Influence of Magnetic Field on the Viscosity Coefficient of Liquids. P. K. Raha and S. D. Chatterjee. *Indian Journ. Phys.* 9. *pp.* 445–454, *July*, 1935.—The paper gives a preliminary account of the results of the investigation on the influence of a magnetic field on the viscosity coefficient of liquids. The following results are obtained:—(1) liquids with long chain aliphatic molecules, *e.g.*, acetone and propyl alcohol (normal), show diminution of viscosity in a magnetic field; (2) liquids of the aromatic class, *e.g.*, nitrobenzene and toluene and an alcohol with side chains, *e.g.*, iso-amyl alcohol, show increase of viscosity in a magnetic field; (3) carbon tetrachloride, water and aqueous solution of cerium nitrate show no change of viscosity. For nitrobenzene, the change

$d\eta/\eta$ increases linearly with increase of magnetic field, no indication of saturation being observed. The thermal variation of $d\eta/\eta$ for the same liquid is also recorded. AUTHORS.

4128. Influence of Electric Field on Viscosity of Aeolotropic Liquids. Y. Björnståhl. *Physics,* 6. *pp.* 257–264, *Aug.,* 1935.—The viscosity of aeolotropic liquids between two plates has been found to increase when an electric field, steady or alternating, is applied perpendicularly to the plates; this effect is probably due to real or apparent orientation of the axis of the swarms parallel to the electric field. A change of electrical conductivity under shearing stress has also been found. Ordinary isotropic insulating liquids show some apparent decrease in viscosity with a steady field, but this is probably due to electrolysis. AUTHOR.

4129. Viscosity of Oils. R. B. Dow. *Physics,* 6. *pp.* 270–272, *Aug.,* 1935.—The viscosity-volume data of Kleinschmidt and Dow have been examined at various pressures and temperatures for lard, sperm and Pennsylvania medium oil. The viscosity-volume isotherms at 25°, 40° and 75° C. are not identical for any of the oils studied, indicating that viscosity cannot be a function of the specific volume alone. The viscosity-volume curve for lard oil at 25° departs from the one at 75° by an amount sufficient to change the viscosity by a factor of 2·3 at a volume of 0·99, and by a factor of 3·2 at a volume of 0·93. Similar curves for Pennsylvania medium oil at the same temperatures are even more relatively displaced; the discrepancy in viscosity varies from a factor of 3·8 at a volume of 0·99 to 7·6 at 0·94. The three oils do not obey Batschinski's equation at atmospheric and higher pressures up to 4000 kg./cm.^{2} AUTHOR.

4130. Viscosity of Liquid Helium. J. O. Wilhelm, A. D. Misener and A. R. Clark. *Roy. Soc., Proc.* 151*A. pp.* 342–347, *Sept.* 2, 1935.—The change in the viscosity of liquid He with temperature is measured between 4·2° K. and 2·0° K. A marked change in the viscosity takes place at 2·19° K., the temperature of transition of He I to He II. AUTHORS.

See also Abstracts 4106, 4163, 4164.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4131. Astrophysical Observatory of California Institute of Technology. G. E. Hale.** *Astrophys. J.* 82. *pp.* 111–139, *Sept.*, 1935.—An account of the financial and other arrangements making possible the construction of a 200-in. telescope. Experiments with fused silica, while successful to a considerable extent, were abandoned on account of excessive cost in favour of Pyrex: 60-in., 120-in., and finally, two 200-in. discs of this material have been cast. It is proposed to use the Al mirror surface process. Of the types of mounting tested a modified yoke type has been selected. Arrangements have been made to facilitate the use of the instrument and in particular the interchange of the various optical systems for which it will be adapted. The final selection of the site has not yet been made; Palomar Mountain is under consideration, since electric lighting in the valley affects Mount Wilson slightly; the preliminary work for the effective use of such an instrument in the S. hemisphere has not yet been done. Considerable detail of the astrophysical laboratory, instrument shop and optical shop erected at Pasadena for use with the telescope is also given. Two Ross correcting lenses have been constructed for the removal of coma, and experiments with short-focus lenses for camera objectives have been carried out; a lens designed by the British Scientific Instrument Research Association works at *f*/0·35. Other auxiliary apparatus is briefly described. T. L. M.

COMETS AND METEORS.

4132. Origin of Comets. P. Bourgeois and J. F. Cox. *Comptes Rendus*, 201. *pp.* 324–326, *July* 29, 1935.—The authors accept Oppenheim's ellipsoid of frequency in directions of perihelia, and by bringing it into relation with the circumstances of observation of comets, they find a privileged direction situated in the plane of the galaxy, and making an angle of about 90° with the direction of the galactic centre; thus reconciling the theory of capture of comets by the solar system (or galactic origin of the cometary and meteoric material) and verifying the fact that the perihelia are distributed in preferential directions opposed to 180° when the motion relative to the differential rotation of the galaxy is concerned. [See also Abstract 2781 (1934).] A. S. D. M.

COSMOGONY.

4133. Stability of Cosmological Models. N. R. Sen. *Zeits. f. Astrophysik*, 10. *pp.* 291–296, *Aug.* 31, 1935. *In English.*—It is proved that all heterogeneous symmetrical models of the universe, obtained by slow and continuous deformation of the homogeneous Friedmann-Lemaître model, have initially greater rates of expansion than the rate of expansion of the homogeneous model, irrespective of the presence or absence of pressure in the model. But whereas the model is definitely unstable for all deformations for vanishing pressure it is stable for certain deformations and unstable for others in presence of pressure. Stability then depends on additional factors characterising deformation. [See also Abstract 1481 (1935).] AUTHOR.

4134. Temperature of Space from Astronomical Observation. K. Wegener. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 189–194, 1935.—The author computes from the albedo and solar distance of the principal planets, taking the solar constant for the earth as 1·95, values for the absolute effective temperature of the planets. Using the observed temperatures, values of the effective radiation temperature of space surrounding the planets are obtained. Effects of atmosphere and other sources of error are discussed. The results suggest an absolute temperature of about 100° K. in the outer part of the system, 150° K. in the region of the earth. T. L. M.

4135. Radiation Reaction Forces and the Expanding Universe. R. Gunn. *Frank. Inst., J.* 220. *pp.* 167–186, *Aug.*, 1935.—It is assumed that a nova outburst is due to the star breaking into two components each of which then possesses a great thermal asymmetry. It is also assumed that most stars have passed through the nova stage and, therefore, have suffered fission. Radiation from a thermally asymmetric star is then shown to produce an increase in its kinetic energy. Applied statistically to all the stars in the galaxy this leads to the conclusion that, on the whole, the galactic system of stars should be receding from the sun. Observational support is found in the motions of stars of different spectral classes. A similar differential radiation from thermally asymmetrical nebulæ accounts for the expanding universe. It must be assumed that all spiral nebulæ were formed by fission from an initial super-nebula. G. C. McV.

4136. Absolute Parallelism and Metric in the Expanding Universe Theory. G. C. McVittie. *Roy. Soc., Proc.* 151*A*. *pp.* 357–370, *Sept.* 2, 1935.—It is shown that the density and momentum of a fluid filling the universe and exhibiting a velocity-distance relation can be found, to within a factor $\sqrt{(-g)}$, by the use of the non-metrical geometry of distant parallelism. The equation of continuity is the only field-equation used. The factor $\sqrt{(-g)}$ is formed out of the coefficients of the metric and the latter is, within certain limits, arbitrary. Milne's system of fundamental particles arises if the metric is assumed to be Euclidean. If the expressions for the density and momentum are assumed to be invariant under Lorentz transformations, the velocity of the fluid at distance r from an arbitrary origin and at time t is r/t. If invariance under space-rotations alone is assumed, the velocity obeys a more complicated law and the acceleration of the fluid is not zero. The case when the metric is that of the de Sitter universe is worked out as an illustrative example of the latter type of system. G. C. McV.

See also Abstracts 4116, 4137, 4139, 4149.

NEBULÆ.

4137. Speed of Recession of Galaxies. A. S. Eddington. *Roy. Astron. Soc., M.N.* 95. *pp.* 636–638, *June*, 1935.—The author has developed more fully the theory of the limiting speed of recession of the galaxies [see Abstract 1564 (1932)], and gives as a definitive result 865 km./sec./megaparsec. The investigation shows that the Einstein mass must necessarily be the actual mass; the derivation, which is only sketched in the present paper, arises from the conditions for a static arrangement of a system of N particles; relativity theory shows such an arrangement to be an Einstein universe, and if it exists the mass is the Einstein mass; but it is shown from wave mechanics that such arrangement (the ground state) must exist. The number N is the number of elementary particles in the

universe, and is found to be $1 \cdot 573 \times 10^{79}$, which is shown, in view of the theory of the double wave function, to be probably exactly 136×2^{256}.
T. L. M.

4138. Evaluation of Absorption in Galactic Nebulæ. B. Fessenkoff. *Comptes Rendus*, 201. *pp.* 326–329, *July* 29, 1935.—The method described is applicable to the small dark nebulæ within the Milky Way, where the absorption (j') of the dark nebula is compared photometrically with the absorption (j) of the galactic base itself; both therefore being freed from all atmospheric or planetary influences, and thus the separate values from the three sources of absorption can be found. The author represents the terrestrial component by $C_0\ \phi\ (z,A) f(t)$, where the first function $\phi\ (z\ A)$ is determined theoretically, by taking the case of a luminous cloud in the stratosphere at a height about 100 km. The second function $f(t)$, which depends on spherical coordinates, can be deduced at each moment from observations of the night-sky intensity near the celestial pole where the stellar conditions do not vary. Only $C_0 f\ (t_1)$ need be determined, where t_1 is a given instant, and the irregularities of night sky luminosity are eliminated. The photometric observation of the intensity of a bright galactic cloud and that of near obscure nebulæ can thus be compared with the equivalent light of a 5th magnitude star spread over a square degree. Such stellar statistics make it possible (at least near the Milky Way) to divide the observed brightness of the night sky into three distinct components: (1) terrestrial, (2) planetary or zodiacal, and (3) stellar. The Milky Way and its dark nebulæ can thus be regarded as not only outside our atmosphere, but also outside the solar system. A. S. D. M.

4139. Structure of Elliptical Nebulæ. S. Smith. *Astrophys. J.* 82. *pp.* 192–201, *Sept.*, 1935.—The results of some observations of Messier 32, together with the known facts concerning this nebula, form the basis for a discussion of the structure of elliptical nebulæ in general. The following data are derived from the observations: (1) Within 75″ of the nucleus the light from M 32 shows no detectable polarisation; (2) the existence of a definite nucleus is established, and its diameter is found to be $0'' \cdot 8 \pm 0'' \cdot 1$; (3) the spectral type, as determined from small-scale plates, shows no variation along the major axis of the nebula. A discussion of three possible models for the elliptical nebulæ, the gas-sphere or starlike model, the assembly of small particles suggested by ten Bruggencate, and the star-cluster model, indicates that the star-cluster model best accounts for the known facts. On the basis of this theory, assuming that the bulk of the stars are *d*G3, the total number of stars in M 32 is found to be $1 \cdot 9 \times 10^7$ and the central density $8 \cdot 8 \times 10^5$ stars/parsec^3. This extraordinarily high central density is, however, not thought to be a serious objection to the theory.
AUTHOR.

4140. Catalogue of 7889 External Galaxies in Horologium and Surrounding Regions. H. Shapley. *Harvard Coll. Obs., Ann.* 88. 5. *pp.* 107–162, 1935.

See also Abstract 4135.

PLANETS.

See Abstract 4134.

STARS.

4141. Formula for Mean Parallax. W. J. Luyten. *Roy. Astron. Soc., M.N.* 95. *pp.* 671–673, *June*, 1935.—The formula discussed by Smart [see Abstract 1492 (1935)] has already been used and derivations given by the author and others. Applications and limitations of the method are briefly discussed. T. L. M.

4142. Analysis of 18,000 Proper Motions Derived at Leander McCormick Observatory. P. van de Kamp and A. N. Vyssotsky. *Nat. Acad. Sci., Proc.* 21. *pp.* 419–427, *July,* 1935.—Relative proper motions of 18,000 faint stars are measured in 341 regions combined into 105 groups, and with stars of known absolute motion in each region, yield 210 equations of condition with 8 unknowns. A provisional solution for solar motion for the galactic latitude zones give results (which prove final) : secular parallax = 0″·0119 ; long = 32°·8 ; and lat. = + 13°·0. A table is given of mean secular parallax (all stars) for the galactic zones (unit 0″·001), and weighted mean of all stars is 0″·0131, the apex position differing from that for bright stars owing to the high percentage of high velocity stars among the faint. The sun's rotation period = 220,000,000 ± 30,000,000 years and its distance to the rotation axis = 10·5 ± 2·2 kiloparsecs. The general solution values is rather fundamental but may contain systematic errors. There is evidence of obscuration in the Milky Way plane ; a real difference exists between the vertex longitudes for large proper motion and for all stars ; and dwarfs differ from giants by 15° in their direction to the galactic centre. A. S. D. M.

4143. Velocities of Stars of Classes R and N. R. F. Sandford. *Mt. Wilson Observat. Contrib. No.* 525. *Astrophys. J.* 82. *pp.* 202–221, *Sept.,* 1935.—An attempt is made to present in tabular form a list of all the radial velocities of stars whose spectra show the bands of carbon. Twenty class N stars having emission lines of hydrogen give a mean difference of − 21·6 km./sec. between the radial velocities calculated from the emission and those calculated from absorption phenomena. These stars are all variable with a mean period of 407 days and a mean range of 4 mag. From all the data for class N stars the solar motion, mean distance, mean absolute magnitude, longitude of galactic centre and galactic rotation are derived by a least squares method. A subsidiary analysis tends to confirm the reality of the calculated galactic rotation term of 13·4 km./sec. J. E. K.

4144. Analysis of Spectra and Applications to Astronomy. H. N. Russell. *Roy. Astron. Soc., M.N.* 95. *pp.* 610–636, *June,* 1935.—The first part of the paper summarises the present position of spectrum analysis, concluding with a table showing the present position of our knowledge of the various spectra of each element. The table and accompanying notes incorporate information as to unpublished work. The second part deals with the astrophysical applications, stellar classification, identification of lines, problems of " missing " elements, recognition of lines not yet observed in the laboratory, etc. The problems of the quantitative analysis of solar and stellar atmospheres, and of line intensities, are discussed at more length ; bright lines and interstellar lines, more briefly. The identification of ammonia, methane and CO$_2$ in planetary atmospheres is also summarised. At each point outstanding problems are indicated. T. L. M.

4145. Visual Region of the Spectra of Early-Type Stars. R. K. Marshall. *Astrophys. J.* 82. *pp.* 97–110, *Sept.,* 1935.—Twenty-one films and seven plates of eight stars ranging in spectral class from B2 to A2 were measured for wave-lengths. The spectrograms were made with an auto-collimating grating spectrograph and the region in good focus extends from 4713 to 6678 Å. About 56 % of the 357 tabulated wavelengths are considered to be satisfactorily identified. AUTHOR.

4146. Relativistic Degeneracy. C. Møller and S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 95. *pp.* 673–676, *June*, 1935.—The formula for the equation of state of completely degenerate matter has been criticised by Eddington. It is now pointed out that this formula is a consequence of the use of the expression for the energy-tensor current in relativistic quantum mechanics, *viz.* :—

$$\mathrm{T}_{\mu\nu} = \frac{ch}{2i}\left(\psi^* \alpha^\nu \frac{\delta\psi}{\delta x_\mu} - \frac{\delta\psi^*}{\delta x_\mu}\alpha^\nu\psi\right),$$

where $\psi\psi^*$ are certain non-commuting quantities satisfying known commutation rules. The latter condition arises because N electrons in a finite volume have to be considered. Eddington obtains a different result owing to a new definition of $\mathrm{T}_{\mu\nu}$. G. C. McV.

4147. Stellar Configurations with Degenerate Cores. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 95. *pp.* 676–693, *June*, 1935.—The study of stellar models, with cores obeying the exact equation of state for degenerate matter, already begun [see Abstract 1505 (1935)] is continued. The curves of constant mass in a luminosity radius diagram are discussed. The models include more general ones than the standard model. The Hertzsprung-Russell diagram, the Wolf-Rayet phenomenon and the hydrogen-content of white dwarfs receive some further clarification from the present analysis. G. C. McV.

4148. Direction of Star-Streaming in the Galaxy. S. W. Shiveshwarkar. *Roy. Astron. Soc., M.N.* 95. *pp.* 655–663, *June*, 1935.—The direction of star-streaming deviates from the direction to the galactic centre ; this can be accounted for by the assumption of a galactic expansion in addition to the rotation effect. On this assumption the author derives a formula for the angle of deviation in terms of the coefficients of harmonic terms in the radial and transverse stellar motions and the angular velocity of the systematic rotation. The result is compared with observations. T. L. M.

4149. Star-Streaming and Spiral Motion in Stellar System. B. Lindblad. *Roy. Astron. Soc., M.N.* 95. *pp.* 663–671, *June*, 1935.—The theory of asymptotic spiral orbits emanating from a central region of high density in the stellar system [see Abstract 1026 (1935)] is applied to the two star streams, whose nuclei correspond to the Taurus and Ursa Major streamings. Slight disturbances produce asymptotic spiral orbits which have turning points at a maximum distance and return symmetrically. The orbits therefore pass and repass our distance from the galactic centre. This accounts for the wide spread of the streams ; further slight disturbances, especially of returning matter account for the divergence of the vertex from the galactic centre ; matter near maximum distance forms a local system elongated at right angles to the direction of the galactic centre—such an elongation in the line Cygnus-Carina has been observed. Returning matter will tend to be scattered, and the outgoing arms will dominate the general appearance of the system ; certain spiral nebulæ show the required structure including the ring at maximum distance. Certain peculiarities of motion of open clusters and planetary nebulæ in Sagittarius region suggest the necessary density gradient and central force. The question of density gradient is discussed in some detail.

High-velocity stars are also considered ; the theory gives the observed one-sided distribution. T. L. M.

4150. U.V. Absorption Spectrum of Nova Herculis 1934. H. E. Green. *Roy. Astron. Soc., M.N.* 95. *pp.* 694–704, *June*, 1935.—The lines in the u.v. spectrum of this nova are tabulated both as measured and as corrected for the recession-velocity of −380 km./sec. The lines are identified and their origins tabulated. Of the 132 lines measured in the range λλ 3024–3797, five are unidentified and four are doubtful. G. C. McV.

4151. Duplicity of Nova Herculis, 1934. F. Baldet. *Comptes Rendus*, 201. *pp.* 329–330, *July* 29, 1935.—The author confirms by the Meudon telescope the duplicity of the nova found by the Lick telescope on July 4 ; its magnitude oscillated between 7 and 8, and on July 24 the star looked like a close double with position angle in direction 140°, and the components of the same colour but united by a dark filament ; there was no sign of nebulosity. The spectrograms last taken at Meudon showed the nova as nebulous with hydrogen emission of velocity about − 300 km./sec. The doubling probably is due to these masses of gas becoming visible ; this nova therefore resembles Nova Pictoris which became first double, then triple, rather than the average nova which becomes simply nebulous. The indication is that the hydrogen emission is not general, but only from certain special regions of the nova. A hypothetical parallax of 0″·002 is deduced, corresponding to a distance of 1600 light-years, and on December 22, its absolute magnitude must have been about − 7·0 since its apparent magnitude was then + 1·5. A. S. D. M.

See also Abstracts 4135, 4138, 4139, 4140.

SUN.

4152. Two Allied Types of Chromospheric Eruptions. H. W. Newton. *Roy. Astron. Soc., M.N.* 95. *pp.* 650–655, *June*, 1935.—The eruptions, which are observed with the spectrohelioscope in Hα light, consist of ephemeral bright flocculi concurrently with absorption markings possessing high radial velocity. In type A (43 cases recorded in 5 years) emission appears first followed in a few minutes at most by previously invisible dark markings. In type B (5 cases) stable absorption markings already exist and develop the high radial velocity after the emission appears. Examples of each type are fully discussed. Outstanding questions are whether these types are only found associated with sunspots or at least their fading remnants, whether the bright emissions always accompany sudden dissipation of a dark marking, whether the sequence of radial velocities in type A is always outwards and then inwards, etc. T. L. M.

***4153. Factors Affecting U.V. Solar Radiation Intensities. W. W. Coblentz and R. Stair.** *Bureau of Standards, J. of Research*, 15. *pp.* 123–150, *Aug.*, 1935.—A new portable precision u.v. meter was used with various glass filters to obtain the quality and total intensity of radiation in the band 2900–3500 Å. Observations were made at Flagstaff (Lowell Observatory) under various conditions of humidity, air mass, etc. ; and also at Washington and San Juan, P.R. The effect of altitude is discussed. Light fog shows large non-selective absorption ; the reflection from snow is exceptionally high ; at Flagstaff greater transparency was found in the afternoon than forenoon, in autumn than spring, corresponding to reduced ozone. For the same solar altitude (air mass), intensity was slightly higher at San Juan than at Washington, but not sufficiently to produce marked differences in biological effect; these are due to differences of air mass. The biological effect was tested by experiments on the production of erythema; the bearing on incidence of rickets is discussed. T. L. M.

4154. Mechanics and Internal Velocity of Solar Rotation. M. Paul (Berlin). *Gerlands Beitr. z. Geophys.* **44.** 4. *pp.* 376–398, 1935.—The author assumes an extensive vertical circulation, the ascending currents being the more strongly ionised owing to increasing ionisation downwards. Convection currents towards the surface due to positive charges are accelerated in the solar magnetic field. The first part of the paper derives a law of rotation from this conception of the sun's structure; the author's equation gives rotation time for different depths and latitudes in terms of the angular velocity of an assumed core rotating like a solid body. This core rotates in 34 days; the angular velocity increases outwards to the photosphere and decreases thereafter. The formula gives the observed variation with latitude with considerable precision. In the second part the author applies his theory of the solar circulation to sunspot formation and other observed phenomena. T. L. M.

4155. Identifications of Fe^+ Lines in the Solar Spectrum. J. C. Dobbie. *Roy. Astron. Soc., M.N.* **95.** *pp.* 704–709, *June*, 1935.—As the result of an analysis of the polar line spectrum of iron undertaken at the Solar Physics Observatory, Cambridge, many new terms in the spectrum of Fe^+ have been identified and are given in tabular form. AUTHOR.

4156. Influence of Electron Captures on the Contours of Fraunhofer Lines. B. Strömgren. *Zeits. f. Astrophysik,* **10.** *pp.* 237–259, *Aug.* 31, 1935. *In English.*—The problem of the central intensities of stellar absorption lines is considered. The discussion is restricted to absorption lines originating from the ground state. The atomic processes of exciting and de-exciting of the upper stationary state corresponding to the line considered are transitions from and to the ground state together with electron captures on the stationary state and photoionisation from it. The corresponding emission coefficients are evaluated. The resulting fundamental equation governing the radiation field in the stellar atmosphere is discussed. The predictions of the theory concerning central intensities of strong absorption lines are compared with observations. It is possible to account for the observational facts qualitatively, and partly also quantitatively. AUTHOR.

See also Abstracts 4134, 4144.

ZODIACAL LIGHT AND GEGENSCHEIN.

4157. Zodiacal Light. F. Schmid. *Gerlands Beitr. z. Geophys.* **45.** 1–2. *pp.* 5–34, 1935.—The paper is based on extensive observations made over the range of latitude 47° N. to 39° S. during two research journeys. The author made detailed observations on the meteorological conditions as well as diagrams of the position of the light; many of the latter are reproduced. The counterglow was almost always visible, even in the tropics and when the band was invisible. The attempt to obtain a parallax was not successful; the author finds that the observations confirm his view of the light as an atmospheric optical phenomenon, and consequently as not possessing a true parallax. This theory is further developed and related phenomena are touched on. T. L. M.

GEOPHYSICS.

GEODESY.

4158. Determination of Figure of the Earth. N. Malkin. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 133–147, 1935.—By means of Chasles' theorem an integral equation is deduced whereby the distance, ζ, between the geoid and an arbitrary closed surface is determined by aid of gravity observations without assuming condensation of external masses. Solution is simple when the closed surface is a sphere, leading in absence of external masses, to the Stokes formula. For a spheroid an approximate solution accurate to the order of ζ^2 is deduced, and for the general ellipsoid an exact solution in the form of a series of Lamé functions with variable coefficients. C. A. S.

GEOPHYSICS, APPLIED.

4159. Electrochemical Prospecting. A. Belluigi. *Beitr. z. angew. Geophys.* 5. 2. *pp.* 169–177, 1935. *In English.*—Certain difficulties in the electrochemical method of prospecting described by M. Müller [see Abstract 3608 (1934)] are discussed. It is pointed out that the two valves and galvanometers of Müller's apparatus do not segregate and measure only those currents, the primary input and induced polarisation current respectively, which they are supposed to do. On the contrary, the first circuit measures the primary current reduced by the effect of polarisation at the electrodes, whilst the second circuit is not confined to those polarisation effects which arise at the surfaces of contact of buried layers. Both records are vitiated by the presence of parasitic currents due to deconcentration at the non-polarisable electrodes, produced by the passage of the primary current. Experimental verification of the existence of these currents is given. The difficulties can be surmounted by means of an apparatus, details of which will be published at a later date. E. L. J.

4160. Circular Loop Determination of Apparent Resistivity. S. S. Stefanescu. *Beitr. z. angew. Geophys.* 5. 2. *pp.* 182–192, 1935. *In French.*—An exact expression is obtained for the vertical magnetic field at the centre of a circular loop (radius R), carrying a current I of frequency $\nu = \omega/2\pi$ and lying on a plane horizontal surface of a semi-infinite homogeneous medium of conductivity σ. The product of this magnetic field and the radius of the loop is a function of n only, when $n^2 = 2\pi \sigma \omega R^2$. Accordingly, curves, showing the variation of the magnetic field per unit current as a function of n, allow the determination of the apparent conductivity of the ground in a practical case from the measured field and the known conditions of excitation. At low frequencies and for small radii the magnetic field in quadrature with the current is given by $H = 12{\cdot}4 \times 10^9 \nu R \sigma I$, which compares well with Koenigsberger's approximate formula $H = 8{\cdot}3 \times 10^9 \nu R \sigma I$. J. M. B.

See also Abstracts 4098, 4165.

HYDROSPHERE, PHYSICS OF THE.

4161. General Circulation in the Ocean. H. Arakawa and S. Ooma. *Geophys. Mag., Tokyo,* 9. *pp.* 83–104, *June,* 1935.—The circulation in the oceans due to varying density on a rotating globe is examined, and equations derived which give a scheme of oceanic circulation. W. A. R.

4162. Potential Distribution in Infinite Conductors and Uplift Pressure on Dams. G. Ram, V. I. Vaidhianathan and E. McKenzie Taylor. *Indian Acad. Sci., Proc.* 2*A. pp.* 22–29, *July*, 1935.—It is shown by experiments that the distribution of pressure in the sub-soil under dams is the same as the potential distribution in conductors. The theoretical basis of sub-soil pressures under dams is thus established. AUTHORS.

LAND, PHYSICS OF THE.

4163. Visco-Elastic Properties of Pitch-Like Materials. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. 2. *pp.* 433–455, *June*, 1935. *In English.*—In a previous paper [see Abstract 2922 (1935)] the behaviour of these materials under ordinary steady tests was described. The effect of repeated torsional stresses is now described. The stress-strain curve is an ellipse, the shape of which varies according to the period of these repeated twists. The longer the period, the more the major axis of the ellipse tends to become vertical. The moduli of these substances decrease with increase in the period of the repeated twists, while their viscosity increases. The elastic after-effect and the hysteresis are marked. If the material of the earth's crust be assumed to have properties of this sort, coastal deformations and the propagation of earthquake-waves may be easily explained. W. A. R.

4164. Motion of Viscous Fluid Under a Surface Load. N. A. Haskell. *Physics,* 6. *pp.* 265–269, *Aug.*, 1935.—A formal solution is given for the motion of a highly viscous fluid when a symmetrical pressure is applied at the surface. This is applied to the subsidence of a cylindrical body of constant thickness and to the recovery of the fluid after removal of a load. Applying the latter case to the plastic recoil of the earth after the disappearance of the Pleistocene ice sheets, it is found that the geological data imply a kinematic viscosity of the order of 3×10^{21} C.G.S. units. AUTHOR.

4165. Natural Remanent Magnetisation of Eruptive Rocks and their Age and Composition. J. G. Koenigsberger. *Beitr. z. angew. Geophys.* 5. 2. *pp.* 193–246, 1935.—The natural remanent magnetisation J_{rn} of eruptive rocks was measured and compared with the induction J_k of the specimens in the earth's field ($H = 0{\cdot}45$ oe.). The ratio $J_{rn}/J_k = Q_n$ was graphed for rocks according to their age, and is found to be a maximum for quaternary and tertiary rocks which contain ferromagnetic material. The specimens were then heated in the earth's field, and the remanent magnetisation J_{rt} measured at 580°–600° C. From this the ratio $J_{rn}/J_{rt} = Q_{nt}$ was calculated. This quantity is also a maximum for quaternary and tertiary rocks. In a more exact magnetic analysis, the remanence of the ferromagnetic minerals was classified according as the Curie point was (*x*) 350° or less, (*y*) between 350° and 600°, and (*z*) above 600°. In Permian and carboniferous rocks, Q_{nt} is, with a few exceptions, 0·20. Granites, schists and gneisses from the Swiss alps have a relatively high Q_{nt}, namely 0·3 to 0·5, these rocks having been reheated by geological metamorphosis, or by late-tertiary folding. Specimens from Finland and Sweden gave values of Q_{nt} mostly less than 0·3, and it is problematic whether this is due to renewed or continuous heating by large overlying masses during the time up to the mesozoic period. [See also Abstract 744 (1930).] G. E. A.

4166. Form, Drift and Rhythm of the Continents. W. W. Watts. *Nature,* 136. *pp.* 369–379, *Sept.* 7, 1935. (*Supplement.*)—After showing the insufficiency of pure uniformitarianism (Lyell) and cooling (Kelvin) to account for the geological history of the earth, the results of the discovery of radioactivity are traced in greatly extending the time available and accounting for the thermal (Joly) and magmatic (Holmes) cycles, and so explaining periodic outbursts of activity culminating in great movements at intervals of some 150–200 million years. The evidence for and against the Wegener drift theory (continental form, positions of mountain ranges, and similarities of, and glaciation in, the Gondwana deposits of India, Africa, S. America and Australia, as against minor non-correspondences of form, and lack of evidence of actual drift) is balanced slightly in favour of the theory. The possibility of tidal action playing a part in production of nappes is discussed, and lastly the effect on animal evolution of the appearance of grasses in tertiary time, and the development of the brain from ¼ oz./ton in Diplodocus to 3600 times as much in man are considered. C. A. S.

See also Abstract 4182.

METEOROLOGY.

4167. Atmospheric Ozone. W. Ladenburg. *J.O.S.A.* 25. *pp.* 259–269, *Sept.*, 1935.—Reference is made first to the results of Fabry and Buisson, Laeuchli, and Lambrey and Chalonge on the absorption curve for ozone and the methods used to find the mean height of the ozone layer and its changes with seasonal and meteorological conditions. The recent observations of Goetz supplied a new method to determine its vertical distribution. It was found that the limited region where most scattering occurs is greater for shorter wave-lengths and for the sun lower. Curves show the vertical distribution of ozone from recent observations at Arosa, Tromsö, and Regener's balloon ascents. The main part of the ozone is at 15–35 km. with a maximum at 25 km. This varies somewhat with the amount of ozone. R. S. R.

4168. Rates of Ascent and Descent of Free Balloons and the Effects of Radiation on Temperature Records. L. H. G. Dines. *Meteorolog. Office, Prof. Notes, No.* 67 [23 *pp.*], 1935.—Reference is made to existing formulæ to determine the rate of ascent and to the necessity for introducing the air viscosity factor. New formulæ are derived and tables prepared to give the rate of ascent for balloons of different weights and with different free lift. From tests made over small heights and other available data values for the rate of fall are calculated and tabulated. The effect of insolation is discussed for different times of day, for the ascent and descent, and for different heights. Night ascents largely avoid this error but for day ascents the best of the international standard hours to employ is 18 G.M.T. At other hours during the day the error grows with increasing height and may reach several °Abs. R. S. R.

4169. Effective Nocturnal Emission. E. Süssenberger. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 63–81, 1935.—By simultaneous measurements of the effective emission with an Angström pyrgeometer and an actinometer it is shown that with stronger air movements the pyrgeometer gives inaccurate values and mostly too low. On the basis of surface vapour pressure it is mostly not possible to draw definite conclusions regarding the magnitude of the effective nocturnal emission and the magnitude depends upon the distribution with height of temperature and vapour pressure. Comparison of these experimental values with those calculated according to Mügge and Möller's second paper on radiation shows that the latter are too small for zenithal radiation, agreement holds for zenithal distances, z, of 60° to 70°, and calculated values are too large for $z = 0°$ to 60° and 70° to 85°. On clear nights the actinometer shows an effective emission against the earth's surface which increases with the inclination of the actinometer to the earth's surface. The effect is not a simple radiation between the actinometer and earth for the intermediate damp air layer shows a definite radiation which rules the radiation intensity for different actinometer inclinations. This latter radiation intensity can be calculated by Mügge and Möller's method. R. S. R.

4170. Heat Content of the Atmosphere of the Northern Hemisphere. Part II. F. Baur and H. Phillips. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 82–132, 1935.—The outgoing radiation from the earth and its atmosphere, and the long-wave sky radiation were calculated for selected periods of the year for each zone of 10° from 0° to 60° N. and for the polar region 60°–90° N. The transport of heat and water vapour across the 10th, 20th, 30th, 40th, 50th and 60th degree of latitude is derived from the intake of energy found from the transfer of heat and outgoing radiation. Integration of the Schwarzschild differential equations gives both upward and downward radiation for any point. The distribution of temperature, humidity and cloudiness, both meridionally and in the vertical, given by observation, forms the empirical basis of the calculations, approximate formulæ for the vertical distribution of humidity and cloudiness being determined. Using Hettner and Fowle's measurements on absorption greater accuracy in radiation measurements has resulted. For long-wave sky radiation the numerical calculations had to be restricted to the averages of January and July, and the equinoxes, but the theoretical examination and general formulæ are valid for other periods of the year. [For Part I see Abstract 4104 (1934).] R. S. R.

4171. Thermal Stability of the Lower Atmosphere. A. L. Hales. *Roy. Soc., Proc.* 151*A*. *pp.* 624–640, *Oct.* 1, 1935.—In this paper an equation for the conduction of heat due to turbulence is deduced. The equation is then used in deducing an equation for the stability of a compressible fluid when the hotter fluid is below. It is shown that superadiabatic lapse-rates are possible in limited regions of the atmosphere. AUTHOR.

4172. Mathematical Theory of the Graphical Evaluation of Meteorograph Soundings by Means of the Stuve (Lindenberg) Adiabatic Chart. L. P. Harrison. *Monthly Weather Rev.* 63. *pp.* 123–135, *April*, 1935.—To evaluate rapidly the successive heights of observations Stuve's graphical method is used, this being an adaptation of the Hertz-Neuhoff adiabatic diagram with the special humidity correction adopted from the Bjerknes virtual temperature diagram. In the paper (1) the groundwork coordinate system which forms the adiabatic chart is described; (2) the evaluation with it of aircraft meteorological soundings, except the determination of altitude, is shown; (3) the mathematical theory underlying the graphical computation of altitude by means of the chart is developed; and (4) various graphical methods with different degrees of approximation which may be used on the chart to determine successive altitudes are indicated. R. S. R.

4173. Microbarometric Oscillations at Blue Hill. B. Haurwitz, R. G. Stone and C. F. Brooks. *Am. Meteorolog. Soc., Bull.* 18. *pp.* 153–159, *June–July,* 1935. *Reprint.*—Details are given of two series of waves observed at Blue Hill which showed marked fluctuations of pressure, wind velocity and direction. The pressure waves had an amplitude of 0·22 mb, and period 16·7 min., wind velocity an amplitude of 1·5 m./sec. at first and then 2 m./sec. and period 17·4 min., but wind direction was less clear, the period being about 16 min. They were associated with a radiational ground inversion of temperature. The theory of the waves is discussed and compared with observational data, the waves being closely related to billow clouds. Stone in discussing Clayton's statistical study of these oscillations at Blue Hill, 1885–1893, considers they were mainly Helmholtzian waves formed on approaching warm fronts. Brooks quotes details of a case in 1931 with a rising barometer. R. S. R.

4174. Theory of General Circulation of the Atmosphere. Mean Field of Temperature. G. Dedebant, P. Schereschewsky and P. Wehrlé. *Comptes Rendus,* 201. *pp.* 346–348, *July* 29, 1935.—The authors' principle [see Abstract 587 (1935)] is applied to the terrestrial atmosphere, assuming a uniform smooth globe, quasi-permanent régime, and absence of radial or meridional movement. Results substantially support the existing theories of the stratosphere, troposphere, and polar front. C. A. S.

4175. Theory of General Circulation of the Atmosphere. Law of Rotation and Field of Pressure. G. Dedebant, P. Schereschewsky and P. Wehrlé. *Comptes Rendus,* 201. *pp.* 453–456, *Aug.* 19, 1935.—In similar fashion [see preceding Abstract] the vertical gradient of the wind and the winds at the level of the tropopause are deduced, and also the existence of a surface of stratospheric calms inclined in a reverse direction to that of the troposphere is accounted for. Results are illustrated by diagrams. C. A. S.

4176. Influence of the Stratosphere on Development of Weather. H. v. Ficker. *Naturwiss.* 23. *pp.* 551–555, *Aug.* 9, 1935.—A brief summary is given of the discovery of temperature conditions in, and the variation in height of, the stratosphere with latitude and from day to day. Stratospheric processes, with inflow of cold and warm air masses, occur as in the troposphere but with a reverse change of latitude. These produce changes in the height of the tropopause and may also influence changes in surface pressure and pressure distribution, while the stratospheric pressure increase may exceed the tropospheric pressure decrease. For forecasting weather changes it is important to establish the changes in both troposphere and stratosphere. Changes on mountain peaks are often more valuable for this purpose than those at ground level. The difficulty of obtaining stratospheric observations quickly may be overcome by using radio sounding balloon ascents for pressure, temperature and humidity, but international cooperation is required to get a simultaneous record from about 12 points in Europe, N. Africa and the Western Atlantic. R. S. R.

4177. Condensation Nuclei and Suspended Particles in the Atmosphere. Odette Thellier. *Comptes Rendus,* 201. *pp.* 348–350, *July* 29, 1935.—The difficulty due to droplets on the collecting slips of the Owens jet dust counter is removed by thorough cleaning. Using the previously described method [see Abstract 2489 (1935)] the number of nuclei (N) and of dust particles (D) in Paris air averaged for a year 62,500 (3500–260,000) and 290 (10–1320) respectively. D showed a minimum at about 16 hr. and in June, and decreases with rising temperature, improving visibility and after rain; N had a marked maximum in March, but otherwise little definite variation. C. A. S.

4178. Luminous Night Clouds. R. Süring. *Naturwiss*, 23. *pp*. 555–557, *Aug*. 9, 1935.—A summary is given of existing knowledge regarding the height, form, speed, direction of movement, and times of occurrence of these clouds during the year, and since their first observation in 1883. Vestine considers the clouds are of cosmic origin. The author refers to their occurrence after severe volcanic outbreaks and discusses whether the clouds are formed of dry mineralised dust or condensation products. Above the ozone layer a second troposphere must exist with powerful convection in it and condensation products may occur in this layer at 80 km. between the lower layer of nitrogen and the hydrogen above. R. S. R.

4179. Luminosity of the Night Sky. V. G. Fesenkov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 1. *pp*. 25–28, 1935. *In French*.—The illumination is considered to be the sum of three components, (1) terrestrial, in the higher atmospheric levels, due to absorption and diffusion in the troposphere, (2) zodiacal, which increases especially near the ecliptic, and (3) stellar. An expression is first obtained to give the terrestrial illumination at any point in the sky, and for 60° N. the diffused illumination in the troposphere, assumed uniform is one quarter of the direct illumination in the stratosphere. Values are next found for the total illumination at the pole star and the difference is of cosmical origin. At Kotab, 39° 8′ N., values are found and tabulated and agree well with theory, the zodiacal and stellar fractions of the total illumination being 0·36 and 0·40 respectively. R. S. R.

***4180. Hair Hygrometry. A. Pfeiffer.** *Zeits. f. Instrumentenk.* 55. *pp*. 346–347, *Aug*., 1935.—The author refers to his own results [see Abstract 1813 (1933)] on the changes in length of a bundle of hair, their agreement with Pircher's and Kleinschmidt's values, and to the values obtained by Grundmann [see Abstract 1068 (1935)]. He has repeated his tests and found the same values. The negative expansion coefficient found was by extrapolation from measured values. **W. Grundmann,** *Ibid*. 348–349, in reply, shows that his values agree with Pircher's and Kleinschmidt's at 20° C. and 0–20 % relative humidity but for increasing humidity the expansion coefficient of the hairs increases and does not decrease above 90 %. The differences are thought to be due to differences in the preliminary treatment of the hairs, to the time interval between this treatment and the experiments, and to the use of different kinds of hair. He considers it best to renew the preliminary treatment after a lapse of 3 or 4 months. R. S. R.

See also Abstracts 4103, 4138, 4293.

SEISMOLOGY.

4181. Discontinuity in the Dispersion Curves of Rayleigh Waves. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. 2. *pp*. 237–244, *June*, 1935. *In English*.—Calculation shows that in each case where two adjoining strata have a given ratio of rigidities (even when the ratio is but 1/5), there are two dispersion curves of different wave types, not one as was formerly thought to be the case. W. A. R.

4182. Rayleigh and Love Waves Transmitted Through the Pacific Ocean and the Continents. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. 2. *pp.* 245–250, *June,* 1935. *In English.*—Consideration of the propagation, especially of Rayleigh waves, shows a type of stratification of the earth's crust in Eurasia similar to that arrived at by Jeffreys and Stoneley, and for the Pacific Ocean similar to that of Gutenberg. W. A. R.

4183. Decay Constants of Seismic Vibrations of a Surface Layer. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. 2. *pp.* 251–257, *June,* 1935. *In English.*—Instead of considering only the damping effects of a given stratum in the equation of motion for that stratum, the problem of decay is attacked by coupling the effects in two adjoining strata, using simultaneous equations for coupled vibrations in the two layers. W. A. R.

4184. Refraction of a Wave Group. R. Stoneley. *Cambridge Phil. Soc., Proc.* 31. *pp.* 360–367, *July,* 1935.—To reconcile the difference in direction of the wave front and the amplitude front which characterises the refraction of waves, *e.g.*, seismic waves, at the interface between two dispersive media it is necessary to suppose that the amplitude of a wave varies along the crest of the waves, so that the amplitude front is arranged in échelon. The form of the amplitude front is deduced; the refraction of the échelon system is discussed; Rayleigh's theory is generalised; geophysical implications are briefly referred to. [See Abstract 2944 (1935).] J. S. G. T.

See also Abstract 4163.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4185. New Method for Counting Atmospheric Ions and Determining Their Mobilities. J. J. Nolan and P. J. Nolan. *Roy. Irish Acad., Proc.* 42*A*. *pp.* 15–19, *Jan.,* 1935.—The authors describe first the advantages and disadvantages of former types of apparatus. To combine the advantages they used an inner high potential electrode connected to a highly sensitive electrometer and measured its departure from a fixed value using a compensation system and a null method. Measurements of the concentrations of atmospheric small ions are obtained with ease and accuracy and corrections to be applied are only about 2½ %. For Glencree the mobilities found for positive and negative ions were 1·54 and 1·72 cm./sec./volt/cm. respectively, and were greater than those usually given for small ions. R. S. R.

4186. Variation of Potential with Height near the Ground at Kew Observatory. F. J. Scrase. *Meteorolog. Office, Geophys. Mem.* 7. *No.* 67. [12 *pp.*], 1935.—The p.d. between two points 1 m. apart was measured at heights ranging from 1 to 10 m. The greatest difficulty arose from failure of the insulation at potentials exceeding about 5000 V the effect showing at the greater heights and mostly in winter. The observations are classified as those taken in (*a*) turbulent air, and (*b*) comparatively still air. The latter conditions are favourable for the accumulation of volume charge in the air. The results are tabulated and shown graphically. The average potential gradient decrease found is about 3 % in 10 m. For condition (*a*) above, the potential gradient shows a tendency to obey the calculated linear law but the amount of decrease is only about one quarter of that indicated theoretically. For condition (*b*) the experimental results do not show the large decrease given by theory. On the average the volume charge at Kew is very nearly zero but in quiet conditions it is of the order + 0·1 e.s.u./m^3. The results are compared with those found by Norinder at Upsala and Kähler at Potsdam. R. S. R.

4187. Dauzère's Theory of Conduction of Air in Regions Exposed to Lightning. E. Mathias. *Comptes Rendus,* 201. *pp.* 314–317, *July* 29, 1935.—The main facts of Dauzère's theory and the conclusions of Gibrat and Viel are given [see Abstract 2490 (1935)]. It is explained that the negative ions emitted from the ground traverse the electric field to the thunderstorm cloud. Until the cloud is sufficiently near the electric field is not great enough to direct the positive ions with their smaller mobility through this same channel and no lightning flash occurs. The same happens if the electric field decreases temporarily but throughout the period the negative discharge as shown by the St. Elmo's fire will continue. R. S. R.

4188. Disturbing Factors in Ion Measurements with Cylindrical Condensers. N. Weger. *Gerlands. Beitr. z. Geophys.* 45. 1–2. *pp.* 195–201, 1935.—The spontaneous decrease in the residual effect observed in ion measurements with cylindrical condensers is attributed to an influence effect due to imperfect insulation. Various observed irregularities in the behaviour of the apparatus are interpreted in terms of the influence effect. Differences in mobility measurements made in summer and winter are attributed to temperature changes (sunshine effect). F. C. C.

See also Abstracts 4165, 4229.

RADIOACTIVITY.

4189. Absence of Natural Radioactivity in Beryllium. E. Friedlander. *Comptes Rendus,* 201. *pp.* 337–339, *July* 29, 1935.—Carefully purified Be, whether as basic acetate or metal, shows no radioactivity β or γ; that previously reported is due to impurities, probably ThC'' or MsTh. C. A. S.

4190. Thin-Layer Measurements of Radioactive Sources. M. Francis. *J. de Physique et le Radium,* 6. *pp.* 303–309, *July,* 1935.—When the activity of an α-particle emitting substance is measured, errors due to absorption in the substance itself are introduced. They can be minimised by spreading the substance in a thin layer and formulæ for calculating the limiting thickness have been given. The author points out errors which will arise due to the finite size of the particles of the material and describes experiments made upon uranium oxide to test the point. J. E. R. C.

4191. Collisions of α-Particles in Hydrogen. E. Pollard and H. Margenau. *Phys. Rev.* 48. *pp.* 402–405, *Sept.* 1, 1935.—Experiments on the projection of protons by α-particles from Po are described. The variation of the yield of projected protons with α-particle velocity was determined and shows agreement with the Rutherford-Darwin law for low velocities, a smooth rise for higher velocities. No evidence of resonance effects was observed, although experiments were made with the aim of their detection. A discussion is given of the inhomogeneity of the α-particles from Po sources and the limitation it imposes on the observable size of resonance effects. [See also Abstract 2957 (1935).] AUTHORS.

***4192. Radioactivity of Solids Determined by α-Ray Counting. Gladys D. Finney and Robley D. Evans.** *Phys. Rev.* 48. *pp.* 503–511, *Sept.* 15, 1935.—The complete theory of α-ray counting for thin and thick radioactive sources is developed. Tables of the numerical constants required for the interpretation of practical measurements are given. Apparatus and experimental verification of the theory are described. Several new methods for determining the thorium content of geological samples are described. Analyses of a suite of igneous rocks show Th contents between $3{\cdot}9$ and $16{\cdot}5 \times 10^{-6}$ gm. Th per gm., with an average Th/U ratio of 7. Therefore thorium is more important in age and geothermal problems than uranium. AUTHORS.

4193. Energy Spectrum of the β-Rays of Ra E. F. A. Scott. *Phys. Rev.* 48. *pp.* 391–395, *Sept.* 1, 1935.—The energy distribution curve for the β-ray spectrum of Ra E has been measured. The spectrum was found to have a maximum at $3{\cdot}87 \times 10^5$ eV and an end-point at $(15{\cdot}34 \pm 0{\cdot}28) \times 10^5$ eV corresponding to an $H\rho$ of 6604 ± 98. The spectrum was obtained by the magnetic focusing method and the particles were counted by a Geiger counter. The absorption of the β-rays in the counter window was determined and allowed for. The large number of very low energy β-rays found by H. O. Richardson [see Abstract 217 (1935)] was not confirmed. The energy distribution found does not agree with that of Fermi's theory. The results obtained are compared with those of previous investigators. AUTHOR,

4194. Double β-Disintegration. M. Goeppert-Mayer. *Phys. Rev.* 48. *pp.* 512–516, *Sept.* 15, 1935.—From the Fermi theory of β-disintegration the probability of simultaneous emission of two electrons (and two neutrinos) has been calculated. The result is that this process occurs sufficiently rarely to allow a half-life of over 10^{17} years for a nucleus, even if its isobar of atomic number different by 2 were more stable by 20 times the electron mass. AUTHOR.

4195. Soft γ-Rays Emitted in the Artificial Disintegration of Li by Proton Bombardment. A. Eckardt, R. Gebauer, and H. R. v. Traubenberg. *Zeits. f. Physik,* 95. 3–4. *pp.* 210–214, *June* 4, 1935.—The soft γ-radiation previously observed in the bombardment of Li with protons was further investigated using improved apparatus. From absorption measurements with Pb and Cu plates the hardness of the emitted γ-rays was found to correspond to about 90 kV (the X-rays generated had a hardness of 60 kV and could be satisfactorily differentiated from the γ-rays). Measurements were also made of the number of γ-rays and the number of α-particles emitted, under the same conditions. The numbers found agreed in order of magnitude, and it is concluded that the γ-rays must arise as a direct product of the disintegration process and cannot be due to a secondary reaction between the α-particles and Li. W. S. S.

4196. Variation of the Coefficient of Absorption of Hard γ-Rays as a Function of Atomic Number. W. Gentner and J. Starkiewicz. *J. de Physique et le Radium,* 6. *pp.* 340–346, *Aug.*, 1935.—Measurements were made of the coefficients of absorption of ThC″ γ-rays in Li, water, Mg, Al, S, Cu, Zn, Ag and Pb. Two methods were employed: a determination of the absorption curves, and a comparison of the total absorbing power of large thicknesses of the substances. Results are in good agreement with theoretical calculations. N. M. B.

***4197. Examination of Nuclear Processes by the Coincidence Counter. H. J. v. Baeyer.** *Zeits. f. Physik,* 95. 7–8. *pp.* 417–439, *June* 26, 1935.—An apparatus is described in which coincidences between β- and γ-rays and also between γ-rays and protons can be observed. It consists of a number of tube counters surrounding the radioactive material, coincidences between their discharges being recorded by means of a special amplifier. By experiments on Ra (B + C) the qualitative result is obtained that γ-rays are more frequently associated with slow β-particles than with fast. In the disintegration of B by α-particles it is shown that γ-radiation is associated only with the 33-cm. proton group and not with the 75-cm. group. J. E. R. C.

See also Abstracts 4041, 4232, 4349, 4350, 4352, 4371.

RADIATION.

ABSORPTION AND TRANSMISSION.

See Abstracts 4153, 4217, 4240.

COLORIMETRY.

4198. Objective and Subjective Changes of Coloured Lights and Pigments by Coloured Eye Glasses. E. Noteboom. *Zeits. f. Instrumentenk.* 55. *pp.* 317–336, *Aug.*, 1935.—The colour coordinates and colorimetric hue and saturation were calculated for 80 combinations of a pigment or coloured glass and an illuminant (*e.g.*, sunlight, tungsten-filament lamp), representing the range of colours commonly met with in everyday life. The changes in hue, saturation and colour coordinates produced when these 80 colour stimuli were viewed through various " neutral " or coloured protective eye glasses were then calculated from the spectral absorption curves of the glasses and taken as the " objective" colour change. Since, however, after the coloured glasses have been worn for a short time the eye adjusts itself so that originally white stimuli are again seen as white, it is concluded that the subjective colour change must be less than the objective. A quantitative measure of the subjective colour change according to this view is obtained by determining the factors by which the colour coordinates of white light, as modified by the eye glasses, must be multiplied in order to restore them to equality, and then by multiplying the modified colour coordinates of the pigment combinations by the same factors. Calculations on these lines showed that most of the protective eye glasses examined had very little, if any, effect on the subjective appreciation of commonly occurring colour stimuli. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4199. Debye Effect and Delay of the Kerr Effect in Pure Nitro-Benzol. I. Ranzi. *N. Cimento,* 12. *pp.* 285–289, *May,* 1935.—An interferometer method is used to measure the refractive index of nitro-benzol for waves of 7·2 and 3·8 cm., with results 3·6 and 2·7 respectively. The latent period for the dipoles of nitro-benzol is of the order 2×10^{-10} sec., which agrees with the delay of the Kerr effect in the same substance.

H. M. B.

4200. Effect of Magnetic Field on Polarisation of Impact Radiation. W. H. McCorkle. *Phys. Rev.* 48. *pp.* 532–535, *Sept.* 15, 1935.—Sodium D line radiation excited by electrons moving parallel to a magnetic field of 300 gauss or more shows about 16 % polarisation, the major electric vibration being parallel to the direction of the exciting electron beam. In fields below 300 gauss the polarisation is less, decreasing to zero in the absence of a field. That the polarisation changes in a magnetic field must be due to the fact that the $3^2P_{3/2}$ level is a hyperfine multiplet which undergoes a Paschen-Back effect. AUTHOR.

See also Abstract 4218.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4201. Fluorescence of Certain Pure Substances. E. Canals, P. Peyrot and R. Noël. *Comptes Rendus*, 201. *pp.* 208–210, *July* 16, 1935.—In the method described previously [see Abstract 3245 (1934)] for determining the weak fluorescence of pure substances by measurements of depolarisation of the diffused light, the results are inaccurate unless allowance is made for depolarisation in the fluorescence and for Raman scattering not superposed on fluorescence. Taking organic acids where the fluorescence is depolarised and the Raman intensities negligible some new results are given. The depolarisation factors found show a remarkable analogy with Cabannes' results for the first few fatty acids in vaporous state. The depolarisation factor diminishes in passing from formic to valeric acid. Thus the replacement of H by a hydrocarbon radical diminishes the anisotropy. There are two exceptions in the series of 7 acids given. The pure acids studied all give a depolarised fluorescence spectrum extending from 4400 to 4900 Å with a maximum at 4700—the relative intensity of fluorescence compared with the diffusion increasing with number of carbons. J. E.

See also Abstracts 4221, 4231, 4345.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4202. Laminar Diffraction and the Becke Phenomenon. P. R. Pisharoty. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 14–21, *July*, 1935.—A sharp laminar edge examined in direct illumination under a microscope appears as a dark line with asymmetric fringes. Previous theories assuming an abrupt change of phase in the emerging wave-front fail to account for this asymmetry. The simple geometrical explanation of the phenomenon usually given is shown to be inadequate since it fails with normal parallel light. It is postulated that the phase change caused by the edge is not abrupt but gradual and that it extends over a part of the emerging wave-front. The theory of microscopic vision as applied to such a deformed wave-front shows the pattern as observed in focus to be asymmetric and the same postulate also explains the asymmetry in the out-of-focus position, *i.e.*, the Becke phenomenon. Hence both in- and out-of-focus appearances are due to asymmetric diffraction effects at the edge. A. H.

4203. Formation of Image by Plane Band Grating Used in Soft X-Ray Region. F. F. P. Bisacre. *Phys. Soc., Proc.* 47. *pp.* 948–963, *Sept.* 1, 1935.—A theoretical investigation of the reflection of cylindrical waves from a plane grating. It is shown that for a narrow pencil the isophasics become circles with a virtual focus as centre. The position of this focus is found and a formula given for the intensity of the light along the reflected isophasic. It is shown that the dimensions of the grating can be chosen so as to give automatic focussing. The critical length of the grating is determined by the condition that the quadratic term in the expansion for the optical path in powers of distance measured along the grating face from its centre must be $3\lambda/8$. Formulæ for the dispersion and resolution of an optimum grating are given, the resolution being the same as for an ordinary grating. J. E.

4204. Longitudinal Light Scattering in Liquids. S. M. Mitra. *Zeits. f. Physik*, 96. 1–2. *pp.* 34–36, *July* 25, 1935.—The effect described by Plotnikow and others [see Abstract 3419 (1931)] is thought to be due to impurities, *e.g.*, dust in the liquid. A. C. M.

4205. Scattering of Light in Protein Solutions. P. Putzeys and J. Brosteaux. *Faraday Soc., Trans.* 31. *pp.* 1314–1325, *Sept.*, 1935.—The purpose of this paper is to ascertain the relationship of the scattering power of a protein solution to the molecular weight of that protein. To this end solutions of ovalbumin, amandin, excelsin, and hæmocyanin have been examined. It is shown that, if due attention is paid to the minor factors intervening in the scattering phenomenon, the scattering power stands exactly in the ratio of the molecular weights of these proteins; influences such as hydration and ionisation must play an insignificant rôle, if any.
AUTHORS.

***4206. Interference Light Relay for White Light. H. J. P. v. Ohain.** *Ann. d. Physik,* 23. 5. *pp.* 431–441, *Aug.*, 1935.—A beam of light is split into two components at a half-silvered glass plate and the two components are recombined after one has been reflected from a fixed mirror, the other by a mirror carried on a thin silver membrane which is set in vibration by incident sound waves. Displacements of the membrane modify the light path difference of the two components and the light intensity in the recombined beam undergoes interference fluctuations which with suitable adjustment, can be made proportional to the membrane displacement. Thus the sound vibrations are transformed directly into light intensity vibrations. The layer of air confined between the half-silvered plate and the membrane has a natural frequency of vibration well above the practical range for sound waves and the mass and elasticity of the membrane are such that the vibrations of the latter are controlled almost entirely by the air pressure. Thus the amplitude of the light intensity vibrations is proportional to the amplitude of the air vibrations over a frequency range from 10 to 10,000. Experimental tests of the device using a linear response photoelectric cell to measure the light intensities are described.
W. S. S.

***4207. Stigmatic Grating Mountings. H. T. Smyth.** *J.O.S.A.* 25. *pp.* 312–314, *Sept.*, 1935.—The general conditions for the production of stigmatic images with concave or plane gratings are derived. Several practical methods of realising these conditions have been devised using a cylindrical lens with plane mirrors, or a concave mirror alone, between the slit and the grating.
AUTHOR.

See also Abstracts 4199, 4220, 4331.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4208. Effect of Photochemical Fading on the Extension and Tenacity Limits of the Single Rock-Salt Crystal. M. N. Podaschewsky. *Phys. Zeits. d. Sowjetunion,* 8. 1. *pp* 81–92, 1935. *In German.*—A comparative investigation is now described of the mechanical properties of the photochemically unfaded and faded single rock-salt crystal, and both visual and photographic data are recorded. It is found that an increase of extension limits for a degree of fading (produced by X-radiation) corresponding to an absorption coefficient of $K_{max} = 5 \cdot 5 \times 10^{-3}$ mm., may attain 230·6 % with an average of 143·3 %; under the same conditions the tenacity limits may attain an increase of 104·4 % with an average of 75·6 %. Crystals faded by means of u.v. light show no difference from those faded by X-radiation. Photochemically faded crystals retain their increased extension and tenacity limits. Full experimental details with photographs are included.
H. H. Ho.

4209. Photography in the Remote Ultra-Violet. G. Rathenau. *Physica*, 2. *pp.* 840–842, *Aug.*, 1935. *In German.*—The technique of fluorescence-sensitising ordinary plates by covering them with a thin film of lubricating oil is improved by previously bathing the plates in a solution of a dye, transparent in the range studied but opaque to longer-wave radiation. Examples of hydrogen line-spectra obtained by bathing in solutions of nitrosodimethylaniline, methyl orange and fuchsine show good resolution in the region of 160 $m\mu$. L. V. C.

4210. Absolute Colour-Sensitivity of Photographic Materials. M. Biltz. *Phys. Zeits.* 36. *pp.* 559–563, *Aug.* 15, 1935.—The absolute sensitivity (computed as erg^{-1} $cm.^2$ to produce density 0·1 above fog on development for 7 min. at 18° C. in the Din 4512 developer) of typical Agfa films, over the spectral range 400–700 $m\mu$, was determined by comparing 18 spectrograms obtained with regularly stepped exposure times. Absolute calibration was effected with a thermo-element. Full consideration is given to maximum errors at every stage and estimates given for probable overall error. L. V. C.

4211. Silver Iodide and Sensitivity. T. Slater Price. *Phot. J.* 75. *pp.* 447–449, *Aug.*, 1935.—A review. The fact that maximum sensitivity in silver iodobromide emulsions is met at an iodide proportion of only some 5 % is not explained by the " strain " theory of photo-sensitivity in mixed-crystal systems. In the light of Hedvall's work (*Chem. Reviews*, 15. *pp.* 139–168, 1934) chemical reactivity in solid systems is shown to be greatly enhanced by traces of foreign substances; silver iodide is in a metastable condition when in the cubic lattice typical of the iodobromides in commercial photographic emulsions and is hence postulated as the primary photo-sensitive constituent of such emulsions. L. V. C.

4212. Fading of the Latent Image on Standing. M. C. Hylan and J. M. Blair. *J.O.S.A.* 25. *pp.* 246–248, *Aug.*, 1935.—There is generally a change in the latent image between exposure and development and the examination of this change in the presence of desensitisers has resulted in apparently contradictory results. These results are shown to be possible, however, by accepting the theory that the developable latent image is the result of two simultaneous reactions, one a forward reaction tending to make the silver halide grains developable, and the other a reverse reaction tending to return the developable grains to the undeveloped state. It has also been shown that heat has the same effect as light on a photographic emulsion, so that the storing of emulsions at ordinary temperatures should be analogous to storing them under a faint illumination or long wave-lengths. If the above theory is correct, an effect similar to the Herschel effect is to be expected in which the reversal of the latent image would be asymptotically approaching an equilibrium density, this being higher the higher the storing temperature. Experimental results on nine plates in three groups, the first bathed in water, the second in pinakryptol yellow and the third in pinakryptol yellow and KBr, prove the theoretical considerations to be correct, the storing temperature for the three plates in each group being 40°, 20° and 0° C. respectively. R. C. F.

***4213. Photoelectric " Densitograph." L. Lobel.** *Soc. Franç. Phot. et Ciné., Bull.* 22. *pp.* 128–133, *June*, 1935.—Describes a null densitograph which uses two photoelectric cells in opposition, but has no amplifier. Two beams of light from a single light source, and at 90° to one another, each pass through two condensers, one being brought to a focus on a neutral wedge, the other focusing on a copy of the wedge. The first beam, after passing through the wedge, falls on a photoelectric cell, the other being made parallel after going through the copy of the wedge. It reaches the second photoelectric cell after traversing another neutral wedge placed so as to oppose the copy. By displacing the copy and wedge in the same beam, in opposite directions, the galvanometer can be kept at zero, changes in the lamp voltage being taken care of by the photoelectric cell in the wedge-lamp beam. Finally, the apparatus is made self-recording by the addition of a suitable mechanical arrangement attached to the carriers of the wedge and copy. R. C. F.

***4214. New Microdensitometer. S. Jacobsohn and W. H. Kliever.** *J.O.S.A.* 25. *pp.* 244–245, *Aug.*, 1935.—The instrument is a Hartmann pattern densitometer in which the photographic wedge is replaced by a neutral dyed gelatin wedge, for which the law of increase of density is linear; this avoids the disadvantages at once of local density variations and of defocusing. Arrangement is made to introduce a grain plate as required to facilitate comparisons. Also the sliding cube of Hartmann is abandoned in favour of a horizontal silvered reflecting strip interrupted centrally so that a single line is available for comparison while the spectrum is visible above and below the strip for identification. The instrument is adapted only for spectrum-line intensity. T. L. M.

4215. Effect of Water on Distortion of Photographic Films. A. Charriou and Suzanne Valette. *Phot. J.* 75. *pp.* 516–520, *Sept.*, 1935. —A quantitative study of the effects of atmospheric moisture and of bathing in water, with or without subsequent drying, upon the dimensions of photographic films of cellulose acetate and nitrate, with or without emulsion coating. The changes are greater and less regular with the acetate though they take place more slowly. Whereas the effect of atmospheric moisture is reversible, bathing in water with subsequent drying produces a resultant shrinkage, the magnitude of which depends upon rate of drying and is generally greater with emulsion-coated than with uncoated material. L. V. C.

See also Abstracts **4244, 4318.**

PHOTOMETRY.

4216. Standardisation of Photo-Cells for Visible Light. H. H. Poole and W. R. G. Atkins. *Roy. Soc., Phil. Trans.* 235*A*. *pp.* 1–27, *Aug.* 7, 1935.—Describes the use of a carbon arc and other sources for standardising photo-cells intended for use in the measurement of visible light, particularly daylight. Sixteen different kinds of cells were investigated, including three photo-e.m.f. cells. The various precautions taken, and the corrections applied are described in detail. Besides the carbon arc the sources used were (1) a tungsten-filament lamp operating at a colour temperature of 2360° K., and (2) a similar lamp with a colour filter giving artificial "mean noon sunlight." J. W. T. W.

***4217. Recording Spectrophotometer. A. C. Hardy.** *J.O.S.A.* 25. *pp.* 305–311, *Sept.*, 1935.—Improvements are described which have been made to a recording spectrophotometer already described in detail [see Abstract 2432 (1929)] and employed then for measuring the spectral reflection or transmission characteristics of materials. Details of an integrating attachment are also given. A. H.

See also Abstracts **4153, 4210, 4213, 4214.**

POLARISATION.

***4218. Polarisation of Resonance Radiation of Ca and Influence of Weak Magnetic Fields. A. Steinhaüser.** *Zeits. f. Physik*, 95. 9–10. *pp.* 669–686, *July* 1, 1935.—The construction of a special resonance radiation vessel is described. The degree of polarisation for the Ca line 4227 is found to be 76·5 % instead of the theoretical value of 100 %. The depolarisation is considered due to the influence of other Ca atoms or rare gas atoms. The depolarising effect of neighbouring atoms was investigated at varying pressures and by extrapolation to zero pressures the uninfluenced degree of polarisation works out to 95 %. The depolarisation and rotation produced by a magnetic field ($H \perp E$) shows a similar course with increasing field intensity as obtained by Hanle, Keussler, etc., with Na and Hg. From the depolarisation the mean life of the excited state of 4227 comes out to $2 \cdot 2 \times 10^{-8}$ sec., and this agrees with the value obtained from the rotation. J. E.

4219. Polarisation of Resonance Radiation. P. Soleillet and S. Nikitine. *Comptes Rendus*, 201. *pp.* 201–203, *July* 16, 1935.—The degree of polarisation in the light emitted is observed when Cd atoms are excited by unpolarised light of wave-length 3261 Å, (1) when the atoms issue from a jet in a small furnace, and (2) when the vapour is produced by heating up the metal in a quartz tube, so that the vapour was not directed. The degree of polarisation was the same (84 %) in both cases, within the experimental error. A. C. M.

4220. Polarisation of Scattered Radiation. Part I. Rayleigh Scattering. S. M. Mitra. *Zeits. f. Physik*, 96. 1–2. *pp.* 29–33, *July* 25, 1935.—The depolarisation of the unmodified scattered light is investigated in CS_2 and in benzene for a number of different wave-lengths. It is found that the depolarisation is independent of the wave-length. A. C. M.

4221. Theory of Polarisation of Photoluminescence of Dyestuffs. A. Jablónski. *Zeits. f. Physik*, 96. 3–4. *pp.* 236–246, *Aug.* 22, 1935.—Formulæ are obtained for the degree of depolarisation of the rotation-free molecule. The assumptions are—that the emission is temporally separated from the absorption process, that each electron jump is associated with a special spacially anisotropic oscillator (*Ersatzoscillator*), the direction of vibration in the emitted light is independent of that in the exciting light, that the intensity components parallel to the principal axes of the molecules are proportional to the corresponding probability of transition, that these three components are incoherent and that the excitation probability of a given molecule depends on the orientation of its axes with regard to the direction of vibration in the exciting light. In the case where the luminescence is excited by the exactly corresponding absorption band, the depolarisation (defined as $1-P/1+P$, where P is the degree of polarisation) varies from 1 for a completely isotropic molecule to 1/3 for a completely anisotropic one. If the excitation is by an absorption band which is not directly connected with the fluorescence band the depolarisation factor varies from 1/3 to 2. Negative values of the depolarisation can occur. J. E.

RADIATION, EMISSION.

4222. Refractive Index of Solutions of Electrolytes in Water with Free Electric Waves. A. Dember. *Ann. d. Physik*, 23. 6. *pp.* 507–528, *Aug.*, 1935.—A stationary electric wave (λ_0 in air = 92·5 cm.)

is produced in the electrolyte between a parabolic reflector and a plane mirror, the wave-length λ in water being obtained by resonance. The refractive index is then $n = \lambda_0/\lambda$. The results for HCl, NaCl, and $MgSO_4$ agree within the limits of error with the Debye-Onsager-Falkenhagen theory. Measurements on urea up to concentrations of 1 gm.-mol./l. agree with other results showing an increase of dielectric constant of $2\cdot85 \pm 0\cdot4$ units. A decrease of $1\cdot25 \pm 0\cdot4$ is observed for a $0\cdot22$ *N* solution of $HgCl_2$; this is probably due to the admixture of the $HgCl_2$ molecular dipole with the dipole of water. H. M. B.

4223. Dispersion in an Ionised Medium under the Influence of an External Magnetic Field. G. Goubau. *Hochfrequenztechn. u. Elektroakustik.* 46. *pp.* 37–49, *Aug.*, 1935.—A dispersion formula is derived for the case of a medium comprising electrons and ions, and a number of dispersion curves are given which show the relationships between refraction index and absorption coefficients for various wave-lengths, numbers of collisions and ratio of ions to electrons. Regarding the ionosphere as a combination of electrons and ions, the reflection conditions for vertical incidence of the wave are investigated. The effect of the ions is to bring the reflection points of the ordinary and extraordinary waves nearer together, to make the absorption of the wave smaller and to cause reflection to appear which is not possible in an electron gas. E. T. A. R.

4224. Measurements of the Absorption of Radio Waves in the Ionosphere. F. T. Farmer and J. A. Ratcliffe. *Roy. Soc., Proc.* 151*A*. *pp.* 370–383, *Sept.* 2, 1935.—The reflection coefficients of the two magneto-ionic components of radio waves, of length 50 to 500 m., reflected at vertical incidence from the ionosphere, have been measured at different times of day. The results are interpreted in terms of Appleton's magneto-ionic theory, and are found to suggest the description given of the ionosphere as an absorbing medium. In the day time considerable absorption occurs in a region in which the refractive index is nearly unity, and which is situated below the maximum of the E-region (the D-region of Appleton and Ratcliffe). At night there is very little absorption except near the top of the wave trajectory, and the magnitude of this absorption is consistent with an electron collisional frequency of $1\cdot5 \times 10^8 \sim$ in the F-region. The ordinary wave is appreciably absorbed only when it is group-retarded. The absorption of the extraordinary wave reflected from the F-region takes place in the E-region and increases as the magneto-ionic wave-length, 214 m., is approached. AUTHORS.

4225. Secondary Effects of Cosmic Primary Radiation. A. Schwegler. *Zeits. f. Physik*, 96. 1–2. *pp.* 62–75, *July* 25, 1935.—By coincidence experiments with several argon-filled tube counters arranged in a variety of ways, it is established that the coincidences observed in the presence of thick absorbing sheets are due to single ionising rays and not to an intermediate secondary process. F. C. C.

4226. Absorption of Cosmic Secondary Radiation. O. Zeiller. *Zeits. f. Physik*, 96. 1–2. *pp.* 121–136, *July* 25, 1935.—To illustrate the difficulty of obtaining reliable measurements of the absorption of the secondary radiation arising from the incidence of cosmic radiation on Pb, experiments with counters are described. In coincidence observations taken with three counters beneath a sheet of lead, the rate of production of coincidences differed comparatively little for different dispositions of the counters, and it is deduced that a diffuse and relatively soft radiation is also present. It was found that on account of this the results of absorption measurements depended upon the width of the absorber and its position. An arrangement of counters and screens is described by means of which reliable absorption measurements can be obtained. Measurements with Pb and Al showed mass-proportionality between the absorption coefficients. D. H. F.

4227. Cosmic Radiation at Innsbruck (590 m.) and on the Hafelekar (2300 m.) during 1934. R. Steinmaurer. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 149–183, 1935.—The apparatus used were essentially as before [see Abstract 4538 (1934)], either (I) uniformly protected by 10 cm. Pb, or (II) left unprotected on top. Cosmic radiation was measured from April to December with I at Innsbruck, and with I and II on the Hafelekar 5·7 km. distant. Results were strictly comparable *inter se* and with previous results. Allowance was made for change of temperature inside the apparatus; changes in that of the atmosphere (due to variation in intensity of scattering, amount of water vapour, and of dust) caused a decrease of 1–2 mJ/°. The reality of the barometer effect was confirmed. The mean of the period was 1·736J at Innsbruck, and 2·769J on the Hafelekar (with I), residual ionisation being about 30 mJ. Ionisation was slightly higher in winter and during snowfall, but unaffected by cloud, rain, or potential gradient, or (at Innsbruck) in thunderstorms, but on the Hafelekar II showed an increase of 0·8 %, I a smaller decrease therein. C. A. S.

4228. Directional Survey of Cosmic-Ray Intensities and Its Application to the Analysis of the Primary Cosmic Radiation. T. H. Johnson. *Phys. Rev.* 48. *pp.* 287–299, *Aug.* 15, 1935.—Continuing previous work [see Abstract 2867 (1934)] and using an automatic multi-directional intensity comparator, asymmetries in the intensity of cosmic radiation have been studied by the coincidence counter method at several stations in Mexico and Colorado. The completed survey now includes data at high (4300 m.), low (sea-level) and intermediate elevations at the geomagnetic equator, in the intermediate latitudes λ29°, and in the high latitude λ50°, together with additional data at latitude λ36°. Combining the experimental results with the theoretical work of Lemaître, Vallarta and Bouckaert, relative specific intensities of the unbalanced positive component are found to vary exponentially with the atmospheric path traversed. On computation of the latitude and longitude effects for the positives alone, it is found that between Panama and Peru, the former is greater than that observed while the latter is less. It is suggested that the anomaly arises from the oversimplifying assumption that the earth's magnetic field is that of a simple doublet. F. C. C.

4229. Cosmic Radiation and Earth's Magnetic Field. E. M. Bruins. *Physica*, 2. *pp.* 879–891, *Aug.*, 1935. *In German.*—The conceptions of magnetic equator, meridian and latitude, are carefully considered, and new definitions are given. The resulting modifications of the theoretical treatment of the effect of the earth's magnetic field on the cosmic radiation are discussed. D. H. F.

4230. Analysis of Cosmic-Ray Deflection Experiments. Part II. W. E. Danforth, Jr. *Frank. Inst., J.* 220. *pp.* 377–386, *Sept.*, 1935.—The method of analysing the results of cosmic-ray deflection experiments, developed in a previous paper [see Abstract 2008 (1934)] is here extended to the case where the region of uniform deflecting field is of the same width as that of the counters. In this form it is applicable to the electrostatic deflection experiment of Lenz, and to the electrostatic and magnetic experiments of W. F. G. Swann and the author. The magnetic experiments of Curtiss and of Mott-Smith are re-examined in the light of the energy distribution recently published by Anderson and Neddermeyer. The latter's result is found to be not inconsistent with the assumption that the induction B gives the correct force; the result of the former requires the addition of low energy rays to the distribution.

AUTHOR.

***4231. Production of Light. M. Pirani.** *Illum. Eng., London,* 28. *pp.* 253–258, *Aug.,* 1935.—Discusses the production of light first from theoretical considerations and secondly from the practical point of view, dealing with the important question of energy balance. The subject is considered under the following sections: theory of light production; different forms of spectra; phosphorescence and fluorescence; efficiencies of illuminants; and practical applications of electric discharge lamps. This last section deals with continental uses of discharge lamps, mention being made of two scientific applications—the filtering out of spectral lines by colour screens, and the sodium primary standard of light. R. C. F.

See also Abstracts 4178, 4313, 4321, 4338, 4351.

RADIATION, GENERAL THEORY.

4232. Neutrino Theory of Light. R. de L. Kronig. *Physica,* 2. *pp.* 854–860, *Aug.,* 1935. *In German.*—Continues the study of the relation between the neutrino and radiation fields [see Abstract 3012 (1935)]. It appears that there are radiationless states of the neutrino field which nevertheless correspond to a finite density of neutrinos. This result is fundamental for Jordan's theory since the neutrino was first introduced to avoid the difficulties associated with the conservation of energy in radioactive-ray emission, and it must be possible for neutrinos to be present and yet unobservable. W. S. S.

See also Abstracts 4114, 4295.

REFLECTION. REFRACTION AND DISPERSION.

4233. Reflection of Binary Cu-Ni Mixed Crystals. P. Bergmann and W. Guertler. *Zeits. f. techn. Physik,* 16. 8. *pp.* 235–236, 1935. —Former tests on these crystals by Littleton were confined to the D-line, but as Cu has strong selective reflection in the visible region the tests were extended over this region. Homogeneous samples with graded percentages of Cu were used. The reflection values found were tabulated and expressed as a function of the percentage of Ni. The selective reflection of Cu was found to disappear when the percentage of Ni exceeded 25 and it was then the same as pure Ni. No connection could be found between this phenomenon and other physical properties of Cu-Ni alloys, although magnetic susceptibility may change similarly. R. S. R.

4234. Reflecting Power of Cu, Zn, Ni and Hocheimer Alloys. F. Hlučka. *Zeits. f. Physik,* 96. 3–4. *pp.* 230–235, *Aug.* 22, 1935.— The measurements fill a gap. The reflecting powers follow an anomalous curve. In conjunction with existing photoelectric data regularities formerly merely surmised can now be experimentally confirmed. J. E.

4235. Reflection of Light from Point Source by a Finitely Conducting Flat Mirror, with Application to Radio Telegraphy. B. van der Pol. *Physica*, 2. *pp.* 843–853, *Aug.*, 1935. *In English.*—Obtains in a new form the solution of the problem of an electric or magnetic dipole placed above an infinitely extended but finitely conducting mirror. The solutions obtained, which are exact, take the form of space integrals over the part of the conducting medium lying below the image of the source, and have a direct physical interpretation. In radio telegraphy the problem corresponds to the case of a vertical dipole aerial placed at a certain height above the earth. An analogy is drawn between reflection by a finitely conducting but perfectly plane mirror and by a mirror of infinite conductivity, not perfectly smooth. W. S. S.

4236. Laws of Geometrical Optics. M. Herzberger. *Kodak Research Lab., Comm. No.* 555. *J.O.S.A.* 25. *pp.* 295–304, *Sept.*, 1935.—It is shown that all the optical laws may be derived from the law of refraction (Snellius-Descartes); that there is for any two-dimensional manifold of rays a certain differential invariant, and that this fundamental law includes all other known optical laws as special cases—it may therefore be used for developing geometrical optics systematically. The value of this method is shown by its application to the problems of Gaussian optics, for which all the theorems are systematically developed according to the methods given. A. H.

4237. Variation of Refractive Index of Unannealed Glass with Time. Niuta Klein. *Comptes Rendus*, 201. *pp.* 339–341, *July* 29, 1935.—The refractive index of similar glass plates [see Abstract 3470 (1935)] heated to 600° and rapidly cooled was determined at a series of points immediately, and after intervals of 3·5 and 12·5 months. The results for any point are expressed by $n_t = n_\infty - 6{\cdot}2 \times 10^{-3}\, e^{-1.17\times 10^{-2} t}$. The minimum and final values of n are 1·51369 and 1·51989 respectively. The half change is complete in about 5, the whole in 50, years. These changes are attributed to slow transformation of β- into γ-glass.

C. A. S.

4238. Refractive Index of an Optical System. E. Roll. *Zeits. f. Instrumentenk.* 55. *pp.* 379–382, *Sept.*, 1935.—For an optical system it is often desirable to have a constant focal length, otherwise for each calculation the boundary and zonal rays must be found and differences would occur in measuring the thickness and radius of the lenses. It is usually arranged that when the elements of the system are changed the focal length shall remain constant by refraction through the last surface. A description is given and axial calculations are made to obtain the radius of the selected surface which shall provide the constant focal length. A numerical example is given. R. S. R.

4239. Optical Anisotropy of Molecular Crystals as Illustrated by Some Oxalates. S. B. Hendricks and W. E. Deming. *Zeits. f. Krist.* 91. *pp.* 290–301, *Sept.*, 1935. *In English.*—The optical anisotropies of a number of oxalate crystals are accounted for by the anisotropy and orientation of the oxalate group in the various lattices. Molecular interaction is found to be serious only in the presence of highly polarisable ions. These applications follow some general developments relating to the optical anisotropy and mean refractive indices of a system of molecules. [See also Abstract 2821 (1935).] AUTHOR.

4240. Optical Properties of Solids. A. H. Wilson. *Roy. Soc., Proc.* 151*A*. *pp.* 274–295, *Sept.* 2, 1935.—Since the optical constants of solids are independent of the temperature in the visible and u.v. regions, the derivation of equations, using the Kramers-Heisenberg dispersion formula is simplified. In the solution of these equations, it is found unnecessary and even clearer not to assume the size of the crystal as small compared with the wave-length. For metals, especially for Ag, the dispersion formula gives results for the threshold for internal photoelectric absorption, which show no great discrepancy with experiment, as a consequence of considering the structure as face-centred. The relation between dispersion and absorption for insulators is discussed, and it is shown that the internal photoelectric effect is proportional to nk, where n is the refractive index and k the absorption coefficient. So k can reach high values, while nk is still small. The Appendix is devoted to a proof of the f-sum rule for a metal. H. M. B.

4241. Improved Vision With the Telescope. J. Flügge. *Zeits. f. Instrumentenk.* 55. *pp.* 367–373, *Sept.*, 1935.—The difficulties arising from physiological differences in human eyes are first discussed and the results of Löhle, Krüger and Zennek, and Kühl are considered. A formula is derived for the sharpness of vision $S = 0\cdot373 \log [1\cdot5 + 1000\, E/(2y_P)^2]$ where S is the sharpness of vision, E the illumination and $2y_P$ the mean diameter of the pupil for E. For a telescope with magnification Γ' the expression becomes

$$S_F = 0\cdot373\ \Gamma' \log [1\cdot5 + 1000\, (2y_{PF})^2\cdot\tau\, E/(2y_P)^2]$$

and the improvement in the sharpness of vision is always $< \Gamma'$. The dependence of S_F/S on E is given for Galilean and prismatic telescopes in tables and diagrams. For the Galilean telescope the curve is relatively flat but for the prismatic telescope it dips appreciably, especially as the entry aperture decreases. After a sufficiently great degree of illumination no improvement in sharpness of vision occurs but for low illuminations there is a big improvement. The theory was confirmed by practical tests [see Abstract 1807 (1930)]. R. S. R.

***4242. Optical Theory of Telescopes with Movable Internal Lenses. A. Haerpfer.** *Zeits. f. Instrumentenk.* 55. *pp.* 373–377, *Sept.*, 1935.—The optical theory for the paths of rays of light through the system of lenses is given and illustrated by diagrams. The successive positions of the image formed by the train of lenses in a 154 mm. Wild telescope is shown diagrammatically. R. S. R.

***4243. Plotter for High Oblique Air Photographs. E. L. M. Burns and R. H. Field.** *Canad. J. of Research*, 13. *Sect. A. pp.* 22–33, *Aug.*, 1935.—A machine for plotting maps from high oblique air photographs has been developed under the direction of the Associate Committee for Survey Research. It is designed for use in mapping to the small scales which meet ordinary Canadian requirements, and is not intended to compete with the more elaborate machines now in use for large-scale mapping. A short description of the plotter is given, and is followed by an account of two experiments, in the first of which it was used to produce a contoured map by a method that involved establishing the position of the camera at exposure from control points fixed by ground survey. In the second experiment the planimetry of a typical area in northern Canada was plotted, with no control other than altimeter elevations of the aircraft, and the elevation of a large lake. The time expended on these experiments was recorded, but in view of the experimental nature of the work and the

need shown for minor improvements in the machine, these results are not a true measure of the efficiency that may be developed in practical mapping.
AUTHORS.

***4244. Projection Viewer and Enlarger. C. F. Smith.** *Journ. Sci. Instruments*, 12. *pp.* 288–291, *Sept.*, 1935.—A description is given of a projector designed for the examination to an enlarged scale of spectrograms, or other photographic records. Various modifications render it suitable for the inspection of small form gauges, screws, gears, etc., as an episcope for the inspection of surfaces, metal or otherwise, or as a comparator for spectrograms. The observer can work comfortably in daylight.
AUTHOR.

See also Abstracts 4131, 4199, 4207.

SPECTROSCOPY.

4245. Temperature Classification of Samarium Lines. A. S. King. *Astrophys. J.* 82. *pp.* 141–191, *Sept.*, 1935.—Wave-length, intensity in arc and furnace, and temperature classification are given for 4477 lines. The wave-lengths are partly new; the u.v. region requires further study. 2800 lines belong to SmI; 442 fall into classes I and II, giving a basis for a term analysis. The furnace was highly effective in developing the neutral spectrum, largely faint in the arc; a large proportion of new lines were measured. The furnace also gave the more sensitive SmII lines. The relative intensity of SmI and SmII in the arc appeared to depend on the intensity of vaporisation. A strong u.v. spectrum peculiar to the spark probably arises from SmIII. The doublet structure of many lines, especially of SmII, is described and measurements are given for the best resolved lines.
T. L. M.

4246. Spark Spectrum of Chlorine. K. Murakawa. *Zeits. f. Physik*, 96. 1–2. *pp.* 117–118, *July* 25, 1935.—A revision and extension of previous work [see Abstract 3072 (1931)]. A. C. M.

4247. New Energy Levels in Au II, Hg III, Tl IV, Pb V and Bi VI. J. E. Mack and M. Fromer. *Phys. Rev.* 48. *pp.* 357–366, *Aug.* 15, 1935. —All the previously unknown $5d^{10}$, $5d^{9}6s$ and $5d^{9}6p$ levels in all the stable members of the Pt-like isoelectronic sequence and some $5d^{9}6d$ and $5d^{9}7s$ levels are identified. The $5d^{9}6pl_{0}$ levels are found in consequence of Goble's predictions [see Abstract 4253 (1935)]. New $d^{9}s$ screening numbers and Houston parameters are given. Ionisation potentials are estimated up to $87{\cdot}9 \pm 0{\cdot}7$ V for Bi VI. Analysis of a partly resolved hyperfine structure pattern attributed to Bi VI gives a value for the splitting factor $a(6s) = 3{\cdot}1 \pm 0{\cdot}2$ cm.$^{-1}$. J. E. K.

4248. Far U.V. Spectra of Argon. J. C. Boyce. *Phys. Rev.* 48. *pp.* 396–402, *Sept.* 1, 1935.—The term tables of A II, A III and A IV have been revised or extended upon the basis of new wave-length measurements in the extreme u.v. A few lines of A I previously known have been remeasured. In the other stages the known lines have been remeasured and new lines added as follows: 23 in A II, 57 in A III, 23 (including some intersystem combinations) in A IV, and 10 in A V (where none were previously known). These results confirm the identification of the nebular lines λ4711·4 and λ4740·2 as due to "forbidden" transitions in A IV. The intervals in possible pairs of "forbidden" lines from A III and A V are discussed. Accurate ionisation potentials are given, 15·69 V for A I, 27·80 V for A II and 40·78 V for A III, while rough estimates yield 61 V for A IV and 78 V for A V.
AUTHOR.

4249. Absorption-Coefficient of the Hg Resonance Line 2536·5 Å. G. P. Balin. *Phys. Zeits. d. Sowjetunion*, 8. 1. *pp*. 93–99, 1935. *In German*.—The theory of the resonance-scattering method is described, and it is shown the method gives value for the absorption-coefficient of the mercury resonance line consistent with those obtained by other methods. A. C. M.

4250. Spectrum of Trebly Ionised Cerium. R. J. Lang. *Canad. J. of Research*, 13. *Sect. A. pp*. 1–4, *July*, 1935.—The spectrum of cerium has been photographed from λ3600 to λ500 Å by means of a 2-m. grating of 30,000 lines/in. mounted in a vacuum spectrograph, using the vacuum spark and the spark in nitrogen as sources. An analysis of the spectrum of Ce IV results in the location of the 6S − 6P, 6P − 6D, 6P − 7S, 5D − 6P, 6P − 8S and possibly the 6P − 7D multiplets. The ionisation potential is approximately 33·3 V. AUTHOR.

4251. Spark Spectrum of Cerium. K. Haspas. *Zeits. f. Physik*, 96. 5–6. *pp*. 410–430, *Aug*. 31, 1935.—The spark spectrum of Ce resembles the arc spectrum of La. About 430 lines in the former spectrum between λ1912 and λ5812 are arranged in a system of terms the lowest of which is a ^{2}D term. It is assumed that corresponding to the lowest energy state in the ionised Ce atom the electronic arrangement is the same as that in the neutral La atom. For some of the terms, *g*-values are derived from measurements of the Zeeman effect; difference between these values and Landé *g*-values are determined. The interval rule is not obeyed. The second ionisation potential of Ce has the value 14·8 V. J. S. G. T.

4252. Isotope Abundance in Platinum. B. Venkatesachar and L. Sibaiya. *Indian Acad. Sci., Proc.* 2*A*. *pp*. 101–103, *July*, 1935.—The relative abundance of the isotopes of Pt is estimated from an analysis of the microphotograms of the structure pattern of Pt I λ3408·13 Å ($a^3F_4 - z^5D_4^\circ$). Assuming a positive isotope shift, the isotopes of Pt with their relative abundance are as follows:

Mass number	196	195	194	192
Relative abundance	16	13	10	~2

[See also Abstract 3870 (1935).] AUTHORS.

4253. Four-Vector Problem and Its Application to Energies and Intensities in Pt-like Spectra. A. T. Goble. *Phys. Rev*. 48. *pp*. 346–356, *Aug*. 15, 1935.—The general expression for the matrix $a_1 l_1 \cdot s_1 + a_2 l_2 \cdot s_2$ which is required in the theoretical treatment of two electron systems is derived by a method based on the correspondence principle which is simpler than the method by which it was previously derived by Johnson [see Abstract 1244 (1932)]. The theory is checked by means of Mack's data on the $5d^96s$ and $5d^96p$ configurations of Pt I, Au II, Hg III, Tl IV, Pb V and Bi VI. Of the seven parameters contained in the secular equations one is determined from the triplet width in $5d^96s$ and the other 6 from 6 relations between the observed intervals. The intervals computed from the secular equations by means of these values of the parameters are in satisfactory agreement with the experimental values. A second method of computation gives less satisfactory agreement with experiment. It is shown how the intensities in intermediate coupling of lines in the transition array $5d^96s - 5d^96p$ may be calculated. The intensities of $5d^{10} - 5d^96p$ are also found. The calculated intensities agree satisfactorily with observations. J. E. K.

4254. Atomic Energy States for Excited Helium. W. S. Wilson. *Phys. Rev*. 48. *pp*. 536–537, *Sept*. 15, 1935.—By means of Slater's method the total atomic energies for the excited states, $1s^2$, $1s2s$, $1s2p$, $2s^2$, $2s2p$ and $2p^2$ of helium have been calculated with the use of Hartree functions previously published. [See also Abstract 2408 (1935).] AUTHOR.

4255. Spectrum of Bromine Flame in Hydrogen. T. Kitagawa. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 262–264, *July,* 1935. *In English.*—About 43 red-degraded bands between λλ5600 and 6875 are observed in emission in the flame of Br_2 in H_2. They belong to the Br_2 system, $0^+_u \rightleftharpoons {}^1\Sigma^+_g$, previously investigated in absorption. Similarly, about 18 emission bands of the corresponding Cl_2 system are observed between λλ5590 and 6500 in the Cl_2 flame in H_2. In both cases all the measured band-heads are expressed by the formulæ derived by other investigators for the absorption bands, with $v' = 4$ to 13 and $v'' = 4$ to 6 for Cl_2, and $v' = 5$ to 21 and $v'' = 1$ to 7 for Br_2. The mechanism of the reaction is discussed. W. J.

4256. Absorption and Fluorescence of Cadmium and Zinc Halide Vapours. E. Oeser. *Zeits. f. Physik,* 95. 11–12. *pp.* 699–716, *July* 12, 1935.—The absorption spectra of CdI_2, $CdBr_2$, $CdCl_2$, ZnI_2, $ZnBr_2$, and $ZnCl_2$, down to 1500° Å have been studied. CdI_2, ZnI_2 and $CdBr_2$ show several distinct maxima, but the others are simply continuous, with a general shift to the red with increasing temperature. Comparison is made with the work of Walters and Barratt. While some absorption bands ascribed by these authors to CdCl and CdBr, belong to the corresponding thallium halides, others observed by them and found by the present authors in $CdCl_2$ vapour belong to CdCl. Fluorescence observations on the iodides indicate that the long-wave continuum corresponds to a decomposition to MI + I′ (where I′ = metastable iodine). The neighbouring absorption maximum corresponds to decomposition MI′ + I where MI′ is the excited iodide. The MI then emits a band system. $CdBr_2$ acts similarly except that the first maxima corresponding to decomposition into CdBr + Br′ is not present. The normal salts give no fluorescence. Since in no case was there found a decomposition with light absorption into an unexcited state, it is concluded that the halogen compounds are atom-molecules. In conclusion the absorption maxima (in volts) are tabulated for the various substances in various states. J. E.

4257. Emission Band-Spectra of Metallic Salts. P. Mesnage. *Comptes Rendus,* 201. *pp.* 389–391, *Aug.* 5, 1935.—A brief description of the spectra emitted by chlorides of Fe, Cr and Co. The experimental arrangement is as previously described [see Abstract 3506 (1935)]. The spectra are attributed for the most part to diatomic molecules, FeCl, CoCl, CrCl. A. C. M.

4258. Absorption Spectrum of Tin Sulphide. E. N. Shawhan. *Phys. Rev.* 48. *pp.* 521–524, *Sept.* 15, 1935.—The absorption spectrum of tin sulphide between 3200 Å and 4600 Å has been photographed at moderate dispersion and between 4000 Å and 4600 Å at high dispersion. The system in the near ultra-violet may be represented by the formula: $\nu = 28{,}336{\cdot}2 + 332{\cdot}77(v' + \frac{1}{2}) - 1{\cdot}42(v' + \frac{1}{2})^2 - 488{\cdot}25(v'' + \frac{1}{2}) + 1{\cdot}47(v'' + \frac{1}{2})^2$. This formula is not in agreement with that given by Butkow and Tschassowenny [see Abstract 4564 (1934)] who seem to have incorrectly assigned the system origin. A new system has been located in the visible which is limited by predissociation to two v'' progressions. These bands are given by the formula:

$$\nu = 23{,}287{\cdot}67 + 367{\cdot}5(v' + \tfrac{1}{2}) - 488{\cdot}25(v'' + \tfrac{1}{2}) + 1{\cdot}47(v'' + \tfrac{1}{2})^2.$$

The observed isotope structure of the strong bands in this system confirms their vibrational assignment. AUTHOR.

4259. U.V. Absorption Spectra of Cis- and Trans-Dichloroethylenes. H. E. Mahncke and W. A. Noyes, Jr. *J. Chem. Phys.* 3. *pp.* 536–540, *Sept.*, 1935.—The absorption spectra of cis- and trans-dichloroethylene have been photographed from the visible to 750 Å. There are continua in the quartz region and at short wave-lengths, but discrete bands in the general region of 1300 to 1700 Å. Two Rydberg series have been found in the cis-form predicting ionisation potentials of 9·58 and 9·63 V. A value in agreement with these figures is found by electron bombardment. No Rydberg series were found in the trans-form, although indications of an ionisation potential at about 11·3 V were obtained by electron bombardment. In both forms the main progressions involve a $C = C$ frequency of about 1400 cm^{-1}, although many prominent differences involving the lowest deformation frequency have been found. A discussion of the various absorption regions has been given, although definite proof of many points must come from other sources. AUTHORS.

4260. Near U.-V. Absorption Spectrum of Diacetylene. Sho-Chow Woo and T. C. Chu. *J. Chem. Phys.* 3. *pp.* 541–543, *Sept.*, 1935.—The absorption spectrum of diacetylene gas was investigated down to 1900 Å. In the region 2860–1900 Å more than eighty bands were found. Some regularities in the spectrum and the similarity with the cyanogen u.v. absorption spectrum are described. Resemblance between the diacetylene and cyanogen molecules is briefly discussed. AUTHORS.

4261. Absorption Spectra and Dissociation Energies of Cyanic Acid and Isocyanates. Sho-Chow Woo and Ta-Kong Liu. *J. Chem. Phys.* 3. *pp.* 544–546, *Sept.*, 1935.—The absorption spectra of gaseous isocyanic acid, methyl, ethyl and phenyl isocyanates have been observed in the ultra-violet. The long wave-length limits of the continuous absorption found were as follows: HNCO, 2240; CH_3NCO, 2550; C_2H_5NCO, 2480; C_6H_5NCO, 2420 Å. In the case of isocyanic acid, diffuse bands were also found in the region 2570–2250 Å. Characteristic absorption bands due to an excitation in the benzene ring were found in phenyl isocyanate. The structures are probably represented by the formulæ $H - N = C = O$, $CH_3 - N = C = O$, $C_2H_5 - N = C = O$, $C_6H_5 - N = C = O$. The products and energies of dissociation have been described. The absence of the characteristic absorption due to $> C = O$ has also been discussed. AUTHORS.

4262. Vibration Frequencies of Ethylene and Ethane. E. Teller and B. Topley. *Chem. Soc., J. pp.* 885–889, *July*, 1935.—Experimental data on the infra-red and Raman spectra and specific heats of ethylene and ethane are summarised, and the vibration frequencies deduced. A systematic notation for the vibrations based on the molecular symmetry is introduced. Ethylene has three symmetry planes; the plane of the molecule is denoted as γ, the plane perpendicular to the C–C bond is called α, and the remaining plane β. The subscript t denotes a total-symmetrical vibration. The other vibrations are denoted by the plane to which the vibration is anti-symmetrical. Further, to distinguish vibrations having the same symmetry character, indices such as CH are used, indicating in this instance that mainly an extension of the C–H bond is involved. The 12 ethylene frequencies ν_t^{CH}, ν_t^{CC}, $\nu_t^{CH_2}$, ν_γ^{M}, ν_α^{CH}, $\nu_\alpha^{CH_2}$, ν_β^{CH}, ν_β^{M}, $\nu_{\alpha\gamma}^{M}$, $\nu_{\alpha\beta}^{CH}$, $\nu_{\alpha\beta}^{M}$, $\nu_{\alpha\beta\gamma}^{M}$, are respectively 3019, 1623, 1342, 1097, 2990, 1444, 3110, 950, 1160, 3240, 730, 1110 cm^{-1}. The index M denotes that the vibration consists mainly in a change in orientation of the CH_2 group;

the allocation of these frequencies among themselves is uncertain. In the case of ethylene, the notation must be extended to cover the two-fold degenerate vibrations; these are denoted by a prefix 2. The frequencies are allocated as follows: ν_i^{CH}, ν_i^{CC}, $\nu_i^{CH_2}$, ν_a^{CH}, $\nu_a^{CH_2}$, ${}^2\nu^{CH}$, ${}^2\nu^{CH_2}$, ${}^2\nu^{M}$, ${}^2\nu_a^{CH}$, ${}^2\nu_a^{CH_2}$, ${}^2\nu_a^{M}$, are respectively 2955, 993, 1460, 3020, 1370, 2890, 1480, 827, 2899, 1460, 750 cm.$^{-1}$. A. C. M.

4263. Vibration Frequencies of Chlorine Derivatives. Hua-Chih Cheng and J. Lecomte. *Comptes Rendus*, 201. *pp*. 199–201, *July* 16, 1935.—The authors' measurements of infra-red frequencies between 640 and 1400 cm.$^{-1}$ facilitate the interpretation of Raman scattering experiments on the same substances. (1) *Chlorine frequencies*: Substances of type $ClCH_2 - R$ (where R is one of CN, COH, COCl, COOH, $COOC_nH_{2n+1}$) have in the infra-red and Raman spectra one frequency characteristic of the Cl between 740 and 790 cm.$^{-1}$. In those of the type $Cl_2CH - R$, the two chlorine atoms form with the C to which they are attached an angular group. This possesses three frequencies. The deformation frequency ω_2 varies between 282 and 230 cm.$^{-1}$, and appears in the Raman spectrum. The two valence vibrations ω_1 and ω_3 vary between 715 and 775 cm.$^{-1}$, and between 770 and 825 cm.$^{-1}$ respectively, and appear in both infra-red and Raman spectra. ω_1 is strongly polarised in the Raman spectrum, while ω_3 is not, and this allows an unambiguous separation. Assuming the hypothesis of valence forces, the restoring force in dynes/cm. and the angle between the $- CCl_2$ bonds are calculated. Substances of type $Cl_3C - R$ are also considered, but except in simple cases like $CHCl_3$ there are difficulties, which lead the authors to suppose that the influence of the R is small in the mono-chlor-derivatives, greater in the dichlor.- and greatest in the trichlor-derivatives. (II) *Other frequencies*: One vibration $C - C$ has been recognised with certainty, which shows certain regularities in going from compound to compound. The vibrations $C - H$ on the other hand do not show such regularities. Finally, some infra-red frequencies are ascribed to combinations. A. C. M.

4264. Rotation and Vibration of the Methane Molecule. H. A. Jahn. *Ann. d. Physik*, 23. 6. *pp*. 529–556, *Aug*., 1935.—The Schrödinger equation for methane is transformed using Euler angles and normal coordinates. The expressions for the interaction of vibration and rotation deduced by Casimir and Teller and Tisza are thus given a firm basis, and some new terms are discovered, which, however, are only of importance in cases of accidental degeneracy. A general group-theory method is given, and applied to methane, which allows the separation of the rotation eigen-functions into non-combining partial systems. The results of Elert are thus deduced simply and completely. A. C. M.

4265. Investigations in the Infra-Red. Part I. Absorption Spectrum and Molecular Structure of Borates. M. K. Sen and A. K. Sen Gupta. *Indian Journ. Phys.* 9. *pp*. 433–443, *July*, 1935.—An examination of $Pb_3(BO_3)_2$, $Ca_3(BO_3)_2$, $Cu_3(BO_3)_2$, K_3BO_3, $Mn_3(BO_3)_2$ and Li_3Bo_3 between 5 and 15 μ gave results in agreement with the predictions of Cassie [see Abstract 743 (1935)]. By comparing the magnitude of the true force constant with CO_3 and NO_3 it is shown that the bond is not localised as in BCl_3. The slightly positive value of true rigidity reveals that the plane configuration follow the central quantisation more closely than NO_3 or CO_3 and the plane configuration is not due to repulsion of oxygen ions alone. W. R. A.

4266. Infra-Red Spectrum and Structure of F_2O. G. Hettner, R. Pohlman and H. J. Schumacher. *Zeits. f. Physik*, 96. 3–4. *pp.* 203–209, *Aug.* 22, 1935.—A method of obtaining pure F_2O is described. Its infra-red absorption spectrum was determined from the visible out to 27μ. From the results it is concluded that the molecule can be represented by an isosceles triangle with an apex angle of 100·6°. D. H. F.

4267. Infra-Red Absorption of NH and OH Compounds. O. R. Wulf and U. Liddel. *Am. Chem. Soc., J.* 57. *pp.* 1464–1473, *Aug.*, 1935.—Results are given for the quantitative absorption of light in the region 6000–7400 cm.$^{-1}$ (1·65–1·35 μ) by a large number of organic compounds, containing NH, NH_2 and OH groups, in carbon tetrachloride solution. These absorptions are characteristic of the presence of these groups. The use of this material in the identification of the presence of particular groups and in the quantitative estimation of some types of organic molecules is outlined, and illustrations of its application are given. Discussion of the probable origin of such spectra is given and evidence advanced for the existence of measurable influence on these characteristic absorptions through coupling with other groups in the molecule adjacent or near the absorbing groups. It is suggested that this provides a method for the investigation of the structure of some organic molecules through an analysis of such spectra. AUTHORS.

4268. Infra-Red Absorption Spectra of Plant, Animal Tissue and Other Substances. R. Stair and W. W. Coblentz. *Bureau of Standards, J. of Research*, 15. *pp.* 295–316, *Sept.*, 1935.—The present paper describes data on the infra-red absorption spectra of plant and animal substances (cellulose and proteins) as found in nature and, in some cases, in the form of pure material prepared in the laboratory. The region of the infra-red spectrum extending to 15μ was examined. Outstanding among the plant substances examined are samples of pure rubber, and associated materials—styrene, indene, polystyrene, and polyindene. The cellulose materials examined included cellophane (commercial preparation), onion skin, translucent membrane of pith of pokeweed, the seed septum of moonwort, and the seed wing of the cotton tree. The protein materials examined included: dried specimens of chitin (the outer integument of insects), pith of feathers, air bladder of fish, bat's wings, film of dried egg albumin, commercial gelatin, lining of egg shell, and wing of a dragon fly. The miscellaneous substances reported upon are polyvinyl acetate and polyvinyl chloracetate resins, glyptal resin, shellac, and a group of substances of interest in connection with the Raman effect. [See also Abstract 5336 (1933).] AUTHORS.

4269. Infra-Red Absorption Spectra of Linear Molecules COS and DCN. P. F. Bartunek and E. F. Barker. *Phys. Rev.* 48. *pp.* 516–521, *Sept.* 15, 1935.—The discovery of new vibration-rotation bands in the infra-red absorption spectrum of COS has made it possible to determine the vibrational energy level scheme of the molecule. The agreement between theory and experiment is quite satisfactory. The fundamental bands of deuterium cyanide ω_2 at 570 cm.$^{-1}$ and ω_3 at 2630 cm.$^{-1}$ have been measured with grating spectrometers. The former has a strong zero branch at 570·16 cm.$^{-1}$, and the fine structure lines on each side are well separated. From the line spacing the moment of inertia of the molecule is found to be $22\cdot92 \times 10^{-40}$ gm. cm.^{2} A comparison of this value with the corresponding one for HCN, *i.e.*, $18\cdot72 \times 10^{-40}$ gm. cm.^{2}, permits the calculation of the internuclear distances. From the positions of these two bands, together with those of the observed fundamentals of HCN, the zeroth order quadratic potential energy expression is computed. AUTHORS.

4270. Light Absorption and the Double Bond. K. W. Hausser, R. Kuhn and A. Smakula. Part I. Problems and Method (with K. H. Kreuchen). Part II. Polyene Aldehydes and Polyene Carboxy-Acids (with M. Hoffer). Part III. Furane Series (with A. Deutsch). Part IV. Diphenyl Polyenes. *Zeits. f. phys. Chem.* 29. *Abt.B.* 5. *pp.* 363–389, 1935.—This series of papers contains an account of work on the absorption spectra of polyene colouring matters carried out by the late K. W. Hausser [see Abstract 1178 (1934)]. Part I contains a review of the absorption of light by conjugated systems, and a discussion of experimental methods. The use of a grating spectroscope is criticised and the method of photoelectric photometry adopted. In Part II, the absorption spectra of the aldehydes $H_3C-(CH=CH)_n-CHO$ ($n=1, 2, 3$) and of the acids $H_3C-(CH=CH)_n-COOH$ ($n=1, 2, 3, 4$) are recorded. It is shown that the height ($\epsilon_{\max}$) of the bands and their strengths ($\int\epsilon d\nu$) are linear functions of n. With increasing n, the displacement of the bands towards longer wave-lengths decreases regularly, as is also observed in other homologous series. In the corresponding derivatives of furane, as described in Part III, similar behaviour is observed, furane approximating in its behaviour to an aliphatic system of two conjugated double bonds. This is also true of the dicarboxyacid derivatives. The heights of the bands are less than for the corresponding aliphatic polyenes, the difference being independent of n. In Part IV, it is shown that for the ω, ω'-diphenyl polyenes the height of the band of longest wave-length is a linear function of n, whilst the strength of the band is approximately so. The displacement of the band as n increases shows the same regularity as in the other series. A difference in the frequencies of the absorption maxima for solutions in benzene and in alcohol is independent of n. [See following Abstract.] C. B. A.

4271. Light Absorption and the Double Bond. Part V. Low Temperature Absorption Spectra of Compounds Containing Conjugated C=C Double Bonds. Part VI. Fluorescence Spectra of the Diphenylpolyenes. K. W. Hausser, R. and E. Kuhn, and G. Seitz. *Zeits. f. phys. Chem.* 29. *Abt.B.* 6. *pp.* 391–454, 1935.—Measurements of the absorption spectra of compounds containing conjugated ethylenic double bonds in the solid and vapour states and in solution at the temperature of liquid nitrogen are recorded. In the low temperature spectra of the diphenylpolyenes, of the polyene carboxyacids and of lycopin, the frequencies of the bands can be represented by formulæ of the type $\nu = (\nu_o + 37\cdot0\, l + 47\cdot1\, m)\, 10^{12}\ \mathrm{sec.}^{-1}$ ($l, m = 0, 1, 2, \ldots$). The spectra of the diphenyl polyenes contain bands of shorter wave-length which, in position and structure, resemble those of diphenyl. They are attributed to the residual phenyl groups. The spectra of the diphenyl acetylenes are quite different. It is shown that the strongest bands in the spectra of porphyrin coincide with those of the $C=C$ spectrum of the aliphatic polyenes. The fluorescence bands of the ω-ω'-diphenyl polyenes are displaced less with increasing number of double bonds than are the absorption bands, and their intensities become less instead of greater. The dependence of the fluorescence on concentration, solvent, temperature and state of aggregation are in accordance with quenching by collision. Collisions between similar molecules are more efficient than those with solvent molecules. The fluorescence bands observed at $-196°$ C. can be represented by the formula $\nu(\text{cm}^{-1})=\nu_0-1550\nu_1''-1160\nu_2''$, ν_0 being the frequency of the band of shortest wave-length. ($\nu_1'', \nu_2''=0, 1, 2, ..$). The frequency separations of the bands, 1550 and 1160 cm^{-1}, also occur in the Raman spectra and are frequencies of $C = C$. The characteristics of the fluorescence spectra are described and compared with the absorption spectra. Dodekapentaene-acid and isomethyl bixin exhibit almost identical fluorescence spectra. [For Parts I–IV, see preceding Abstract.] C. B. A.

4272. Fine Structure Analysis of the Red Bands of Magnesium Oxide and Isotope Effect. P. C. Mahanti. *Indian Journ. Phys.* 9. *pp.* 455–486, *July*, 1935.—Measurements of the structure lines in the (0, 1), (0, 0), (1, 0) and (2, 0) bands of the red bands of magnesium oxide, MgO, are reported. Each band has two strong P and R branches associated with the main molecule, $Mg^{24}O$, and in most cases they are accompanied by fainter components which are definitely attributed to the two isotopic molecules, $Mg^{25}O$ and $Mg^{26}O$. The two main P and R branches are strictly single and their continuity in the vicinity of the band origin is interrupted by the absence of one line. This structure characterises the system as due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition. AUTHOR.

4273. Near U.V. Absorption Bands of SO_2. R. K. Asundi and R. Samuel. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 30–45, *July*, 1935.—The absorption bands of SO_2 have been measured and the number of recorded bands considerably increased. The analysis of this band system is still to a large extent arbitrary and several arrangements of the bands are possible. Since, however, the symmetric valence vibration of unexcited SO_2, as known from the Raman effect and infra-red spectrum, has nearly the same value as the vibration of the molecule SO, known from its band spectrum, preference is given to an arrangement of the SO_2 bands, by which the symmetric valence vibration of excited SO_2 gains almost exactly the same values as that of excited SO. AUTHORS.

4274. Structure of the "5B" Bands of CO. R. Schmid and L. Gerö. *Zeits. f. Physik*, 96. 3–4. *pp.* 198–202, *Aug.* 22, 1935.—These bands were regarded as the $v' = 1$ progression of the third positive system $b \rightarrow a$, until Asundi attributed them (on ground of differences of rotational structure) to the $v' = 0$ progression of a separate system $b' \rightarrow a$, called the "5B" system on the assumption that a, b and b' were quintet states. Analysis of third positive bands as $b^3\Sigma \rightarrow a^3\Pi$ disproved the latter assumption and suggested that the former interpretation of the still unanalysed 5B bands was correct. The Q-branch lines of 5B band λ2673 show peculiar accumulations and rarefactions, resulting from a series of perturbations which converge towards a limit at $\nu 38036{\cdot}7$ and resemble those in the $b^3\Sigma$ state [see Abstract 3882 (1935)]. If this limit is the known predissociation limit of the Ångström and third positive bands, this band has $B_v' = 2{\cdot}025$, which, with $B_0 = 2{\cdot}058$ (*loc. cit.*) and the original assumption ($v' = 1$), gives $\alpha = 0{\cdot}033$, $B_e = 2{\cdot}075$, and $\omega_{\frac{1}{2}} = 2109$ for the $b^3\Sigma$ state; the last figure is the mean separation of corresponding heads of this band and the third positive λ2833. W. J.

4275. λ4502 Band of NH. R. W. Lunt, R. W. B. Pearse and E. C. W. Smith. *Roy. Soc., Proc.* 151*A*. *pp.* 602–609, *Oct.* 1, 1935.—A new band at λ4502, degraded to the red, has been observed in the spectrum of a hollow kathode discharge in rapidly streaming ammonia. The analysis of the band indicates that it arises from a $^1\Pi \rightarrow {}^1\Sigma$ transition. The rotational term differences for the upper level are identical with those of the $^1\Pi$ level of the λ3240 band ($^1\Pi \rightarrow {}^1\Delta$) of NH previously analysed. Rotational constants for the new $^1\Sigma^+$ level have been calculated. The observations of the $^1\Sigma^+$ level complete the experimental verification of the existence of all the stable states of the NH molecule derived by Mulliken from the ^4S, ^2P, and ^2D states of the N atom and the normal state of the H atom. AUTHORS.

4276. Gross Intensities in Electronic Bands. N. R. Tawde. *Indian Acad. Sci., Proc.* 2*A. pp.* 67–81, *July*, 1935.—The development of the subject of spectral intensities to gross intensities of bands has been reviewed, and the Swan system of C_2 and N_2 (second positive) systems was chosen to treat some aspects relating to the conditions of excitation. The probabilities of transition, the temperature, and the " centres of intensity " are discussed in relation to each other where possible, and an attempt is made to explain some unusual intensity features of bands excited in different sources especially in argon. AUTHOR.

4277. New Interpretation of the Structure of Band-Spectra. S. Bhagavantam. *Indian Acad. Sci., Proc.* 2*A. pp.* 92–100, *July*, 1935. —Electronic excitation of molecules is regarded as occurring as follows: The incident light-wave induces electric doublets in the atoms, with axes either both parallel or both perpendicular to the nuclear axis. In the former case the doublets attract one another, in the latter repel one another, so that the interatomic distance diminishes or increases on electronic excitation respectively. From the observed changes in nuclear distances are deduced the electric moments, and these are found to be of the same order as the permanent moments frequently met with in molecules. If the mutual potential energy of the doublets is added to the nuclear potential energy function, an increase in the vibrational frequency of the molecule results if the doublets are of the attracting type, and *vice versa*. This explains why increase in nuclear distance on electronic excitation is always accompanied by a diminution in the vibrational frequency. Quantitative agreement is found in cases where the change in nuclear distance is small. A. C. M.

4278. Triplet Band Term Formula for the General Intermediate Case and its Application to the $B^3\Pi$ and $C^3\Pi$ Terms of the N_2 Molecule. A. Budó. *Zeits. f. Physik*, 96. 3–4. *pp.* 219–229, *Aug.* 22, 1935.—A development and application of the Hill and van Vleck theory [see Abstract 58 (1929)]. An expression is obtained for combination differences, and the true band constants evaluated. Applied to the $B^3\Pi$ and $C^3\Pi$ terms of N_2 the calculated combination differences agree well with the experimental values over the whole of the observed range. J. E.

4279. Normal State of the He Molecule Ion, He_2^+. S. Weinbaum. *J. Chem. Phys.* 3. *pp.* 547–550, *Sept.*, 1935.—A variation function constructed of hydrogen-like 1*s* functions with different values of the effective nuclear charges for He and He^+ is used in the treatment of the normal state of the helium molecule-ion. The treatment leads to the values $D_e = 2\cdot22$ eV and $r_e = 1\cdot097$ Å for the dissociation energy and the internuclear distance, in good agreement with the experimental values. AUTHOR.

4280. Intensities in $^2\Pi - {}^2\Sigma$ Transitions in Diatomic Molecules. L. T. Earls. *Phys. Rev.* 48. *pp.* 423–424, *Sept.* 1, 1935.—Simple intensity expressions for $^2\Pi - {}^2\Sigma$ and $^2\Sigma - {}^2\Pi$ transitions in diatomic molecules have been developed for cases in which the $^2\Pi$ state is intermediate between Hund's case (*a*) and case (*b*), by specialising the general formulæ given by Hill and van Vleck. Numerical values have been worked out for all branches in typical $^2\Pi$ cases, for low values of J.

AUTHOR.

4281. Heat of Dissociation of H_2 from Spectroscopic Data. H. Beutler. *Zeits. f. phys. Chem.* 29. *Abt.B.* 5. *pp.* 315–327, 1935.—The value for the heat of dissociation of H_2 determined by the author by extrapolation of a resonance band system [see Abstract 318 (1935)] is higher than that deduced by Dieke and Hopfield from the limit of the ultra-violet continuum. This difference is now investigated. The absorption of para-hydrogen and of a mixture of ortho- and para-hydrogen (3 : 1) in the vacuum region is recorded for columns 2 m. long at pressures up to 0·05 mm. It is found that for those molecules which are in the rotation levels $K'' = 0$, 1 and 2, the continuum begins sharply at different wave-lengths. The higher the rotational energy E''_{rot} of the absorbing molecule is, the smaller is the amount $h\nu$ of light energy necessary to produce dissociation into two H atoms (one excited) according to the equation $E''_{rot} + h\,\nu = D_0 + (1\,{}^2S - 2\,{}^2S) - H$, in which the last term is the excitation energy of the H atom. Dieke and Hopfield worked only at higher concentrations, and observed the edge of the continuum for the rotational state $K'' = 3$. The heat of dissociation is now found to be 102·72 k.cal., and this value is compared with earlier determinations. By an improvement of the method used by Dieke and Blue, the value $D_0 \gtreqless$ 103·0 to 103·7 k.cal. is derived from their observations of the predissociation in the Fulcher bands.

C. B. A.

4282. Exchange of Vibrational and Transitional Energy between Excited Iodine Molecules and Rare Gases. F. Rossler. *Zeits. f. Physik*, 96. 3–4. *pp.* 251–267, *Aug.* 22, 1935.—An experimental and theoretical investigation of probability of quenching and of energy exchange between vibrational or rotational and translational energy. The vibrational and rotational transitions are of the same order of probability; the efficiency per collision gives an estimate of the atomic cross-section which is 25 times as great as the gas kinetic value. The collision efficiency in the fluorescence process is ten-fold greater than in Schall dispersion and in vibrational activation. A hypothesis is proposed which takes account of the effect of the colliding mass in all the energy transformations. The extinction effect of rare gases on fluorescence is given a simple interpretation.

J. E.

4283. Stark Effect in Molecular Spectra of Nitrogen, Carbon Monoxide and Hydrogen. W. Rave. *Zeits. f. Physik*, 96. 3–4. *pp.* 276–277, *Aug.* 22, 1935.—In Fig. 6 of the previous paper [see Abstract 2140 (1935)] the P- and R-lines are erroneously indicated. The corrected figure is given in the present paper and it appears now, in contradiction of the previous deduction, that the upper $3^3\Pi$ term of the Fulcher bands is influenced by the electric field whilst no effect of the field on the lower $2^3\Sigma$ term can be proved.

J. E. K.

4284. Intensity-Distribution in the Rayleigh Lines of Compressed CO_2. J. Weiler. *Ann. d. Physik*, 23. 6. *pp.* 493–506, *Aug.*, 1935.—Intensity measurements are made of the "wings" accompanying the scattering of 4047 Å in CO_2 at different pressures up to the neighbourhood of the critical pressure. It is found that the intensity at the middle of the line is proportional to the density-fluctuations in the gas, while at a point approximately in the middle of the "wing" the intensity increases with the density. At larger and smaller distances from the middle of the line there appears at higher pressures evidence of additional radiation connected with the inner molecular state of the compressed gas. A. C. M.

4285. Raman Spectra of Trichloroethanes. G. F. Hull, Jr. *J. Chem. Phys.* 3. *pp.* 534–535, *Sept.*, 1935.—The Raman frequencies of 1,1,1- and 1,1,2-trichloroethane have been obtained. Comparison with CCl_4 indicates that the Cl_3C and Cl_2HC radicals have tetrahedral symmetry. The frequencies of $Cl_3C \cdot CH_3$ and $Cl_2HC \cdot CH_2Cl$ are compared, and the combination frequencies and modes of vibration of the two molecules indicated. AUTHOR.

4286. Raman Spectrum of Carbon Disulphide. A. V. Rao. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 46–53, *July*, 1935.—A detailed investigation of the intensity and polarisation characters of the Raman lines in carbon disulphide. It is found that the Q branch of the principal vibration line 656 cm.$^{-1}$ cannot be separated from the PP and RR branches. The intensity distribution in the latter is similar to that obtained in the wings accompanying the Rayleigh lines in liquids. This line, when excited by λ4358, exhibits a depolarisation of 0·15 and the value increases to about 0·2 if the exciting wave-length is λ4046. The ratio of intensities of the peaks of 656 and 796 Raman lines has been found to be 9·2 whereas the ratio of the total areas under these lines is obtained as 6·6. AUTHOR.

4287. Hindered Rotation and Oscillation of Molecules in Liquids and in Crystals. S. Bhagavantam. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 63–66, *July*, 1935.—The unmodified lines in the spectra of light scattered in liquids are accompanied by " wings." The explanation of these wings based on free rotation of the molecules forming the liquid leads to disagreement with the observed facts. The author suggests that *incomplete* rotations of the type envisaged by Pauling occur. These give rise to separate lines instead of wings when the substance crystallises, and such lines have been observed by Gross and Vuks in diphenyl ether, benzene and naphthalene in the solid state. A. C. M.

4288. Carbon Isotope in Raman Scattering. Part I. S. Bhagavantam. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 86–91, *July*, 1935.—The principal Raman lines in benzene, cyclopropane and ethane shifted by 992, 1188 and 993 wave numbers respectively are found to have feeble companion lines of frequency shifts 985, 1175 and 974. These are attributed to molecules in which one of the carbon atoms is replaced by its heavier isotope C^{13}, *viz.*, $C^{12}_5 C^{13} H_6$, $C^{12}_2 C^{13} H_6$, and $C^{12} C^{13} H_6$ respectively. The positions and the relative intensities agree satisfactorily with this view. AUTHOR.

4289. Raman Effect and Free Rotation. Parts II and III. K. W. F. Kohlrausch, G. P. Ypsilanti and W. Stockmair. *Zeits. f. phys. Chem.* 29. *Abt.B.* 4. *pp.* 274–298, 1935.—The spectra of 19 substances of the type $X \cdot H_2C \cdot CH_2 \cdot X$ are discussed. Results are given for the first time for methylene iodide, malonic nitrile, 1·2 dichloro- and diiodoethane, ethylene bromhydrin, β-aminoethyl alcohol, ethylene cyanhydrin, methoxyacetonitrile, monochloro dimethyl ester, *symm*-tetrachlor ethane, and *meso*-dichloro dibromo ethane. The *trans*-structure predominates at room-temperature and in the homogeneous liquid state. Ten compounds, $H_2C{:}CH \cdot X$ or $H_2C{:}CH \cdot CH_2 \cdot X$, have been investigated, the following for the first time, vinyl bromide, allylamine, α-butylene, and 1,4 butenol. Allyl derivatives and 1·2 disubstituted ethanes in the liquid state occur in two different molecular forms. Butadiene, $H_2C{:}CH \cdot HC{:}CH_2$ occurs only in the *trans*-form. [For Part I see Abstract 635 (1933).] W. R. A.

4290. Raman and Infra-Red Spectra of Saturated Aliphatic Alcohols and Ethylene Hydrocarbons. A. Andant, P. Lambert and J. Lecomte. *Comptes Rendus*, 201. *pp*. 391–393, *Aug*. 5, 1935.—The Raman and infra-red spectra are recorded of the following compounds: dimethyl 2.4. hexanol 4, dimethyl 2.5. hexanol 2, dimethyl 2.4. heptanol 5, dimethyl 2.5. heptanol 5, trimethyl 2.3.5. hexanol 3, dimethyl 2.4. octanol 4, trimethyl 2.4.6. heptanol 4, trimethyl 2.4.7. octanol 4, dimethyl 2.4. hexene 4, dimethyl 2.5. hexene 2, dimethyl 2.4 heptene 4, dimethyl 2.5. heptene 5, trimethyl 2.3.5. hexene 2, dimethyl 2.4. octene 2, trimethyl 2.4.6. heptene 3, trimethyl 2.4.7. octene 4. A. C. M.

***4291. Hydrogen Discharge Tube for Absorption Spectroscopy. W. H. Watson and D. G. Hurst.** *Canad. J. of Research*, 13, *Sect. A*. *pp*. 19–21, *Aug*., 1935.—An inexpensive, easily assembled tube of rugged construction is described. All parts exposed to the discharge are water-cooled. The capillary with its water-cooling sheath is the only glass part, is a self-contained unit and is easy to make. The tube has been operated without trouble at over 2 kW input at 1000 V. AUTHORS.

See also Abstracts 4144, 4207, 4209, 4218, 4219, 4231, 4244, 4326, 4351, 4378, 4382.

VISION.

4292. Inheritance of Congenital Colour Vision Defects. W. Trendelenburg and J. Schmidt. *Preuss. Akad. Wiss. Berlin, Ber*. 2. *pp*. 13–81, 1935.—The Nagel anomaloscope was used in the investigation of 129 cases of defective colour vision, including in many instances two or more cases in the same family. Six tests with the anomaloscope were made for each subject, and these included the description of the field colours for selected " matches" and settings by the subject. It was found necessary to distinguish between the results obtained on first glancing at the test field and after viewing it for some seconds. Of the 129 cases, 39 % were found to be dichromats (26 % protanopes, 13 % deuteranopes) and 61 % anomalous trichromats (13·3 % protanomalies, 47·7 % deuteranomalies). Protanomalies and deuteranomalies were found to form well defined types of colour defect which do not grade into the normal or dichromat types. In all the families studied, with one exception, the type of colour defect was the same for all members of the family not possessing normal colour vision. In the exceptional case, two brothers were respectively a protanope and a deuteranomaly. W. S. S.

4293. Range of Vision and its Determination. H. Sebastian. *Gerlands Beitr. z. Geophys*. 45. 1–2. *pp*. 35–62, 1935.—Gives a critical summary of the literature on the various factors which determine the distance at which objects and light sources can be seen under different atmospheric conditons. W. S. S.

***4294. Photoptometer for Sensitiveness with Low Lights. E. Haas.** *Rev. d'Optique*, 14. *pp*. 248–251, *June–July*, 1935.—A description is given of improvements in an apparatus previously described [see Abstract 4897 (1932)]. It can be used for the measurement of the luminous threshold, but its chief use will probably be for the measurement of the threshold of brilliance which must be given to a background in order that an eye may define there a black test corresponding to a given visual sensitiveness. The apparatus has as source of light a rectilinear vertical filament. This illuminates the first face of a lens which forms an image of the filament a small distance in front of a second lens. This second lens reproduces on a translucid screen the image of the first face of the first lens. A variable horizontal slit is situated in the same plane as the first image. The apparatus is adapted for tests of nocturnal vision. J. J. S.

See also Abstracts 4198, 4241.

X-RAYS.

4295. Effect of Temperature on the X-Ray Scattering of Solids According to Quantum Mechanics. H. Ott. *Ann. d. Physik,* 23. 2. *pp.* 169–196, *June,* 1935.—Taking Dirac's theory of radiation as basis the author gives a wave mechanics analysis of the coherent and incoherent X-ray scattering by a single atom, containing one electron, oscillating about an equilibrium position and by a group of atoms in thermal equilibrium forming either an amorphous substance or a crystal. The effect of temperature oscillations on the X-ray scattering is exhibited as a form of Raman effect in the X-ray region the details of which are worked out. The refinements over the earlier theory of Waller and others are not within the scope of practical measurements. The anomalous behaviour of NaCl at high temperatures is not explained by the present theory. W. S. S.

***4296. Ionisation of Liquid Carbon Disulphide by X-Rays. F. L. Mohler and L. S. Taylor.** *Am. J. of Roentgenology and Radium Therapy,* 34. *pp.* 84–88, *July,* 1935.—The characteristics of the ionisation of liquid CS_2 are investigated by an ionisation method, after purification of the liquid as described. Fields up to 60 kV are used and the current voltage curve shows continuous, but decreasing rate of rise, the form of curve obtained being consistent with the theory of columnar recombination and permitting the rate of production of ions to be obtained, which can be interpreted in terms of *r* units as used in practice, for dosage measurements. It is suggested that the use of liquid CS_2 to replace the air of the commonly used ionisation chamber offers advantages of greater ionisation and, whilst such an instrument has actually been utilised in practice, its possibilities are not generally appreciated. B. J. L.

4297. X-Ray Spectroscopy. E. A. W. Müller. *Zeits. f. wiss. Phot.* 34. *pp.* 181–196, *Aug.,* 1935.—The technique of preparing specimens for X-ray emission spectroscopy is described. The elimination of anode impurities is considered and the special methods necessary in the cases of powders, gases and liquids are discussed. A list of the elements is given, containing particulars of their melting points, thermal conductivity, and such properties as are of interest in the present connection. A list of 190 references is also given. J. T.

4298. K-Spectrum of Silicon. Part I. H. K. Flemberg. *Zeits. f. Physik,* 96. 3–4. *pp.* 167–172, *Aug.* 22, 1935.—Gives the results of the relative measurements of the wave-lengths of the K lines of Si emitted by pure Si, SiC and SiO_2 respectively. A high vacuum spectrometer and a concave crystal of gypsum were used. The wave-lengths of the K lines of Si are shorter in the case of the compounds than for the pure element and the magnitudes of the shifts are given. W. E. P.

4299. Absorption Relationships in the L-Shell. H. Schwarz. *Ann. d. Physik,* 23. 6. *pp.* 571–588, *Aug.,* 1935.—The course of the partial absorption for the 3 L-shell levels of Sn have been investigated quantitatively. The radiation from the 3 levels was excited by monochromatic primary rays and the dispersed rays were examined for relative intensity. Using the filtered $K\alpha$-radiation of Cr, Cu and Mo the measured alteration of relative intensities corresponded to the alteration of partial absorptions. From the known energy jumps in the L-levels and by an assumption as to the course of the absorption in the M-level the absolute value of the partial absorption can be found. It is found that the partial absorption ratios depend on the wave-length of the exciting radiation, the relative absorption of the L_1-level increasing with decreasing wave-length. The actual values of absorptions obtained agree well with the theory of Schur. The efficiency of fluorescence excitation of the L-radiation is of the order 0·12. J. E.

4300. Diffraction of X-Rays by Liquid Na-K Alloy in a Magnetic Field. C. W. Heaps. *Phys. Rev.* 48. *pp.* 491–493, *Sept.* 15, 1935.—Because magneto-resistance is found in the liquid Na-K alloy there is reason to expect that a magnetic field might modify the X-ray diffraction curve of the liquid. Experiment indicates that the diffraction is not changed by as much as 2 % in a field of 2700 gauss. A test made to detect magnetostriction in the alloy indicates no volume change per unit volume greater than 3×10^{-7} in a field of 7800 gauss. The cause of magneto-resistance in the liquid does not, therefore, appear to lie in changes of molecular grouping caused by a magnetic field. AUTHOR.

4301. Measurement of X-Ray Wave-Lengths by Large Ruled Gratings. J. A. Bearden. *Phys. Rev.* 48. *pp.* 385–390, *Sept.* 1, 1935.—The wave-length of Cu$K\alpha$-radiation as measured by a plane grating placed between the crystals of a precision double crystal spectrometer is in good agreement with that obtained from previous ruled grating measurements. Two gratings are used, with 100 and 300 lines per mm. respectively. An ionisation chamber is used. The differences between the ruled grating and crystal results do not depend on the wave-length in the range 1·4 Å to 8·3 Å. Calculations are made of the " true " grating constant of calcite, Avogadro's number, the electronic charge and Planck's constant. The difficulties encountered in using these values of e and h are pointed out. J. T.

4302. Wave-Length Measurements of Ni $L\alpha_{1,2}$ and Ni $L\beta_1$ Lines of Ni and Ni Salts. J. Shearer. *Phil. Mag.* 20. *pp.* 504–513, *Sept.,* 1935.—The wave-lengths and characteristics of Ni $L\alpha_{1,2}$ and Ni $L\beta_1$ from Ni, Ni_2O_3, NiO, and NiS are studied. The wave-length of the maximum (and of the short wave-length edge) is the same for all four substances to within about 1 in 300. Within the same accuracy the frequency difference between the L lines from the metal is equal to that between the Ni $K\alpha_1$ and the Ni $K\alpha_2$ lines. Features are described which characterise the spectra given by the salts. AUTHOR.

4303. False Interpretation of Radiographs. F. Regler. *Phys. Zeits.* 36. *pp.* 530–535, *Aug.* 1, 1935.—The paper deals with the radiography of metal specimens of uneven thickness which are immersed in salt solutions of the same absorbing power as the metal, in order to avoid undue exposure of the photographic film. It is shown theoretically and experimentally by investigations with Al immersed in $BaCl_2$ solutions, that the selective absorption in the Ba must be taken into account and that it can easily lead to false interpretation of the radiograph. It is also shown that in cases where selective absorption has to be considered, a decrease in the X-ray tube potential can cause a decrease in the contrast of the photograph. W. E. P.

4304. X-Ray Investigation of Cu-Sn Alloys. E. A. Owen and J. Iball. *Inst. of Metals, J.* 59. [19 *pp.*], 1935. *Advance Copy.*—The X-ray method of determining the position of phase boundaries in thermal diagrams of alloy systems is applied to study the α-phase boundary in the Cu-Sn system and to preliminary measurements on certain alloys in the γ- and ϵ-phases. It is found that a number of modifications are necessary in the α-phase boundary of the system given in the International Critical Tables. The position of the boundary between 750 and 500° C. is moved towards a higher Sn content, but between 500 and 300° C. towards a lower Sn content. The maximum solubility of Sn in Cu occurs at about 520° C., corresponding to the $\beta \rightarrow \alpha + \gamma$ transformation. The parameter of the γ-phase at 480° C. is measured. Measurements on the ϵ-phase show that it is a solid solution which does not exceed 1·5 % Cu at 380° C. and the atomic volumes of the Cu saturated and Sn saturated ϵ-phases at this temperature are deduced. A number of suggestions are made concerning the γ and ϵ phase transformations. H. J. H. S.

***4305. X-Ray Cameras for Low Temperatures. Barbara Ruhemann.** *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 572–582, 1935. *In German.*—Gives constructional details of two new vacuum cameras one suitable for photographs with rotating crystals and the other for stationary crystals only. The principal feature of the cameras is that only the crystal and not the film is in the evacuated enclosure. In the second camera the vacuum enclosure is a Dewar flask to permit the cooling of the specimen to the temperature of liquid hydrogen, and maintaining it at that temperature to within ± 0·1° C. G. E. B.

See also Abstracts 4087, 4203, 4234, 4309.

HEAT.

CALORIMETRY.

4306. Specific Heat of a Supraconducting Alloy. K. Mendelssohn and J. R. Moore. *Roy. Soc., Proc.* 151*A*. *pp*. 334–341, *Sept*. 2, 1935.—The specific heats of $PbTl_2$ have been measured in the temperature range 3° K.–6° K. A discontinuity in the specific heats which was to be expected according to Rutger's formula did not occur. An explanation for this behaviour is given by considering the magnetic properties of a supraconducting alloy. Conclusions on the constitution of a supraconducting alloy are drawn from the experiments. AUTHORS.

CONDUCTION.

4307. Thermal Conductivity of Sundry Materials. C. D. Niven. *Canad. J. of Research*, 13. *Sect. A*. *pp*. 16–18, *July*, 1935.—The results of measurements on the thermal conductivity of acetylene black, rock wool, sphagnum moss, dried asbestos-water paste and other insulators are given. AUTHOR.

See also Abstracts 4103, 4106, 4171.

CONVECTION.

4308. Smokeless Zone Around Heated Platinum Ribbon. S. Miyake. *Tôkyô Univ. Aeronaut. Research Inst., Report No.* 123. *pp*. 85–106, *June*, 1935. *In English*.—The smokeless zone around an electrically heated vertical Pt ribbon is photographed and analysed by means of a microphotometer. It is found that the breadth of this zone, B, is given by $B = C\theta^a/p$, where θ is the temperature difference between the ribbon and the ambient air, p is the gas pressure, and C and a are constants. For stable smokes such as tobacco smoke, TiO_2, SnO_2, P_2O_5 and black smoke produced by burning benzine the value of B for similar conditions is approximately independent of the smoke used. Considerably greater values are obtained for smokes of H_2SO_4 and NH_4Cl, presumably due to evaporation of these particles. The breadth of the zone is not influenced by radiation from the hot body nor by applied electric and magnetic fields, and is considered to result from air convection in conjunction with the Magnus effect. R. W. P.

See also Abstracts 4103, 4171.

DILATATION.

4309. X-Ray Determination of Thermal Expansion of Cadmium. G. F. Kossolapow and A. K. Trapesnikow. *Zeits. f. Krist.* 91. 5–6. *pp*. 410–423, 1935.—Determined by X-ray methods a increases from $2\cdot9730_9$ Å at 26° to $2\cdot9837_9$ at 189°, c from $5\cdot6059_6$ to $5\cdot6498_4$, the ratio c/a decreasing slightly which indicates increasing deviation from cubic closest packing. The coefficient of expansion ($\times 10^5$) perpendicular to the hexagonal axis increases from $1\cdot73$ between 26° and 100° to $2\cdot21$ between 26° and 189°, that parallel thereto decreases from $4\cdot87$ to $4\cdot83$ for the same intervals. C. A. S.

MELTING AND BOILING POINTS.

4310. Fractionation of Isotopic Isomers by Distillation. D. F. Stedman. *Canad. J. of Research,* 13. *Sect. B. pp.* 114–121, *Aug.*, 1935.—Slight separations of some isotopic isomers have been achieved by equilibrium rectification. In the case of chlorine the total separation amounted to 0·048 atomic weight units; 28·6 % of the O^{18} has also been removed from normal oxygen by the fractionation of water, and in a short run with liquid oxygen the normal concentration of O^{18} has been raised from 0·2 % to 0·25 %. The last-mentioned separation can be carried considerably further with present equipment. CH_3D was synthesised. Its boiling point appears to be 0·5° C. lower than that of methane. The vapour pressures of a 56·8 % solution of D_2O were measured, and it is suggested that the published values of the vapour pressure of D_2O at temperatures lower than 40° C. may be slightly too high. AUTHOR.

***4311. Instrument for Measuring Evaporation from Surfaces. J. S. Owens.** *Journ. Sci. Instruments,* 12. *pp.* 291–293, *Sept.*, 1935.—The design is given of an instrument for measuring the rate of evaporation under varying conditions, from the surface of a sample of sand or soil. The instrument consists of a pan which is supplied with water from a vertical graduated tube, in such a way that the level of the water in the pan is kept constant. Some examples of results obtained with the instrument are given. AUTHOR.

See also Abstract 4091.

TEMPERATURE, MEASUREMENT OF.

4312. Thermodynamic Scale below 1° K. W. H. Keesom. *Physica,* 2. *pp.* 805–806, *Aug.*, 1935. *In English.*—A short note explaining how the thermodynamic temperature scale below 1° K. can be determined experimentally by the adiabatic demagnetisation method without assuming a knowledge of the magnetisation as a function of temperature. L. G. C.

4313. Temperature Scales of Cb, Th, Rh and Mo at 0·667μ. L. V. Whitney. *Phys. Rev.* 48. *pp.* 458–461, *Sept.* 1, 1935.—To establish temperature scales for Cb, Th, Rh and Mo spectral emissivities were measured for these metals at $\lambda = 0\cdot667\mu$. The Mendenhall V wedge was used for Cb and rolled cylinders were used for the other metals. Rolled cylinders were more satisfactory for measuring emissivities than specimens in other forms. Rigorous heat treatment was found necessary for accurate results. Emissivities for all four metals were constant with temperatures. Results are:

	Emissivity $\lambda=0\cdot667\,\mu$	*Temperature range covered*
Cb	0·374	1300°–2200°K.
Th	·380	1300°–1700°K.
Rh	·242	1300°–2000°K.
Mo	·382	1300°–2100°K.

AUTHOR.

***4314. Pocket Thermograph. W. Keil.** *Phys. Zeits.* 36. *pp.* 529–530, *Aug.* 1, 1935.—The construction of a recording thermograph which is contained in a pocket watch-case is described. A bimetallic strip is employed to activate a small magnifying device to which is attached a recording scriber. The graph paper is fixed to a circular face of 5 cm. diameter and this makes one revolution in 24 hours. A simple adjustment enables a desired temperature range to be obtained. H. J. H. S.

***4315. Thermocouple for Vibrating Metal Bars. Mary D. Waller.** *Journ. Sci. Instruments,* 12. *p.* 300, *Sept.,* 1935.—Description of a thermocouple for measuring the temperature of the vibrating bars used in the author's acoustical method of studying the vibrating properties of metals at different temperatures. [See Abstract 751 (1934).]

***4316. Toluene-Mercury Thermo-Regulator. H. Barrell and J. C. Evans.** *Journ. Sci. Instruments,* 12. *pp.* 281–284, *Sept.,* 1935.—A toluene-mercury thermo-regulator is described which is capable, when operated under suitable conditions, of maintaining the temperature of a room constant within ±0·1° C. over long periods of time. AUTHOR.

***4317. Apparatus for Raising or Lowering the Temperature of a Laboratory Furnace. F. Adcock.** *Journ. Sci. Instruments,* 12. *pp.* 285–288, *Sept.,* 1935.—Among other applications the apparatus can be used for the control of a furnace in which thermal analysis is conducted. A thermal curve (thermocouple e.m.f./time) taken in such a controlled furnace, for a specimen devoid of thermal arrests, can be made to approximate closely to a straight line. These furnace conditions facilitate the interpretation of thermal curves obtained for specimens exhibiting weak and diffuse thermal arrests. An essential part of the apparatus is a moving potential divider which provides a steadily increasing or decreasing e.m.f. The latter is opposed to the e.m.f. due to a controlling thermocouple in the furnace, and the resulting small current deflects a mirror galvanometer which operates a photocell. By means of a thyratron and a small electric motor, the photocell ultimately regulates the furnace heating current. The equipment is suitable for controlling a furnace at a distance, as only two pairs of connecting leads are required. AUTHOR.

See also Abstract 4358.

THERMOCHEMISTRY.

***4318. Photographic Investigation of Flame Movements in Gaseous Explosions. Part VII. Spin in Detonation. W. A. Bone, R. P. Fraser and W. H. Wheeler.** *Roy. Soc., Phil. Trans.* 235 A. *pp.* 29–68, *Aug.* 7, 1935.—With the new Fraser high-speed mirror camera flame speeds may be measured accurately in 10^{-6} sec. The results obtained indicate that the detonation wave in gaseous explosions must be regarded, not as a homogeneous shock wave, but as a more or less stable association or coalescence of two separate and separable components—an intensely radiating flame-front with an invisible shock wave immediately ahead of it. The development of persistent " spin " depends on the stability of the association. Thus, detonation in an explosive gaseous medium is the propagation, as a wave, of a condition of intensive combustion, initiated and maintained in a shock wave by radiation from an associated flame-front. Under certain conditions the " head " of detonation begins to rotate in the medium, eventually pursuing a spiral track along the tube quite close to the walls; the medium does not, however, rotate as a whole. The experimental work deals mainly with detonations, under variations conditions in a moist $2\,CO + O_2$ medium. [See also Abstract 1794 (1932.)]. T. H. P.

4319. Influence of Ultra-Short Waves upon the Velocity of Combustion of Gaseous Mixtures. W. S. Rossichin and W. P. Timkowsky. *Phys. Zeits. d. Sowjetunion,* 8. 1. *pp.* 100–104, 1935. *In German.*—The influence of a h.f. electric field on the velocity of combustion of a gaseous mixture composed of 25 % acetylene and 75 % of air is now investigated. It is found that at $6 \cdot 10^5 \sim$ the velocity of flame propagation is $1 \cdot 5 - 2$ times that of a constant field. Further frequency increase to $8 \cdot 10^6 \sim$ indicated the influence to become appreciably smaller. The effect of the field practically disappears at frequencies of the order of $(1 \cdot 5 - 1 \cdot 6)\ 10^7 \sim$. From $1 \cdot 9 \times 10^7 \sim$ the reversed effect is observed, *i.e.*, no velocity decrease, but an acceleration of combustion of the gaseous mixture, which in the e.h.f. field of $3 \cdot 4 \times 10^7 \sim$ increases by 20 %. Based on the latter observations it appears that the ultra-short waves produce activation of the gas mixture at the flame front. [See also Abstracts 2107 and 4248 (1934).] H. H. Ho.

See also Abstracts **4261, 4281.**

THERMODYNAMICS.

4320. Experimental Confirmation of the New Theory of the Equation of State. W. Jacyna. *Zeits. f. Physik,* 96. 1–2. *pp.* 119–120, *July* 25, 1935.—This paper contains a brief review of the experimental work of Hausen, Roebuck and Osterberg (for air and A), and of Kapitza (for He), which is claimed to confirm the author's calculations for the inversion of the Joule-Thomson effect—that above 700 atmospheres for air and 900 for A, no inversion is possible and that for any optional temperature the Joule-Thomson effect is negative. For $p < 700$ atmospheres the inversion for air is at 440° C. ($p = 20$ atmospheres) and at 400° ($p = 40$). Below these temperatures, the effect for A, air, and He is positive. For A the inversion is at − 109° C. ($p = 250$), and at − 138° C. ($p. = 100$); below these temperatures, the effect has increasing negative values both for A and He. From Kapitza's data for He it is concluded that in the interval from 30 atmospheres to 1 atmosphere and at about 20° K, positive high values of the Joule-Thomson effect are to be expected. H. H. Ho.

4321. Relation between Gas Laws, Wien's Displacement Law and Radiation Law of the Gaseous State. E. Wertheimer. *Zeits. f. Physik,* 96. 1–2. *pp.* 137–147, *July* 25, 1935.—It is shown that, under certain simple assumptions, the gas laws are derivable from Wien's displacement law, which can itself be correlated with the radiation law of the gaseous state—an extension of the Stefan-Boltzmann law. J. S. G. T.

4322. Entropy of Manganous Ammonium Sulphate. K. S. Krishnan and S. Banerjee. *Indian Acad. Sci. Proc.* 2*A*. *pp.* 82–85, *July,* 1935.—Kürti and Simon obtain the following result from the work of Debye and Giauque: $T_f/T_i = E_m/E_i = k\theta_m/H_i g\beta$. The corresponding characteristic temperature θ_m is defined by the relation $k\theta_m = E_m$ where k is Boltzmann's constant. If it be assumed that the crystalline Stark-splitting is into $(2J + 1)$ equally spaced energy levels, then $k\theta_m$ would be the energy difference between the adjacent levels. θ_m is thus an important constant which determines the deviation of magnetic entropy of the crystal from its ideal value, and therefore defines the entropy/temperature curve at these temperatures. The present paper calls attention to a method for the calculation of θ_m from measurements of the magnetic anisotropy of the crystal at room-temperatures. Examples are given showing good agreement with the results of Kürti and Simon. This agreement is taken to justify the assumption that the effect of the crystalline field at these low temperatures in orienting the magnetic moments and thus producing a diminution of entropy, is equivalent to the effect of the appropriate Weiss field H_f supposed to act on these moments. It is possible therefore from measurements on the magnetic anisotropy of the crystal at room-temperatures to predict the entropy/temperature curve close to the absolute zero. S. G. B.

4323. Joule-Thomson Coefficient for Nitrogen. W. E. Deming and Lola S. Deming. *Phys. Rev.* 48. *pp.* 448–449, *Sept.* 1, 1935.—Corrected values of the Joule-Thomson coefficient μ for nitrogen are tabulated between − 70 and 600° C., and to 1200 atmospheres. μ contours are exhibited on a p–t diagram. The inversion temperature for zero pressure is found to be about 326° C. AUTHORS.

***4324. Joule-Thomson Effect in Nitrogen. J. R. Roebuck and H. Osterberg.** *Phys. Rev.* 48. *pp.* 450–457, *Sept.* 1, 1935.—The measurements were made with the same apparatus and procedure as in the case of A [see Abstract 5146 (1934)]. The effect of the known impurities in N_2, namely A and O_2, can be safely neglected. The data for the isenthalpic curves are given in detail and are plotted. The values of the Joule-Thomson coefficient μ over the field (− 150° to 300° C. and 1 to 200 atmospheres) are calculated, plotted and tabulated as functions of pressure and temperature. Both upper and lower branches of the inversion curve are measured and the whole inversion curve plotted. The isenthalpic curves, the Joule-Thomson coefficient, and the inversion curve in N_2 are exceedingly like the corresponding phenomenon in air and in A. C_p is spread over the pressure range and agrees well with the values of Deming and Shupe [see Abstract 2735 (1931)], and of Mackey and Krase [see Abstract 2235 (1930)]. AUTHORS.

4325. Designation of Nernst Heat Theorem as Third Law of Thermodynamics. H. Schmolke. *Zeits. f. Elektrochem.* 41. *pp.* 654–657, *Sept.*, 1935.—After a comprehensive discussion of the general validity of the Nernst heat theorem, which certain authors have doubted, the author concludes that the stated conviction of H. Zeise [see Abstract 222 (1934)] in which the theorem is unreservedly claimed to be a third law of thermodynamics, must find general recognition. H. H. Ho.

See also Abstracts 4075, 4091, 4312, 4417.

VAPOUR PRESSURE.

4326. Physical Properties of HBr and DBr. J. R. Bates, J. O. Halford and L. C. Anderson. *J. Chem. Phys.* 3. *pp.* 531–534, *Sept.*, 1935.—The absorption spectra and vapour pressures of HBr and DBr have been measured. The frequency difference between the absorption curves of these compounds is about three times as great as can be accounted for by the zero point energy differences. Theoretical reasons for this effect are discussed. The vapour pressures are almost identical. The application of Trouton's rule to isotopic compounds is discussed and calculated values for the constant are presented. [See also Abstract 3580 (1935).] AUTHORS.

See also Abstract 4310.

ACOUSTICS.

4327. Anomalous Dispersion of Sound in Solid Cylindrical Rods. R. Ruedy. *Canad. J. of Research,* 13. *Sect. A. pp.* 10–15, *July,* 1935.—The deviation of the overtones from whole multiples of the fundamental note when pure longitudinal waves are set up in a cylindrical rod, one to a few cm. in thickness, is accounted for to within less than 1 % by the drop in the velocity of propagation of longitudinal waves with increasing frequency due to radial motion in the rod. The radial component present in vibrating solid or hollow cylinders determines a second solution of the velocity equation which starts near the resonance frequency of the radial vibration. Although radial motion can take place free from longitudinal components, so that no mutual coupling need exist between the two types of vibration, the equation for thin rods can within certain frequency ranges be reduced to the frequency relations valid for coupled systems. AUTHOR.

4328. Acoustical Properties of the Syamisen, a Three-Stringed Japanese Musical Instrument. J. Obata and A. Amemiya. *Imp. Acad. Tokyo Proc.* 11. *pp.* 216–218, *June,* 1935.—The instrument, which is fretless and is played with a plectrum, is used for varied types of music. That known as Nagauta has been studied [see Abstract **1979 (1931)**], and the present investigation deals with the causes of the difference between the Nagauta-syamisen and Gidayû-syamisen. The sounds from Gidayû-syamisens were recorded and analysed, and acoustical spectra are given for the first Nagauta string and for all three strings of the Gidayû instrument. These show that in the former the two most prominent harmonics have frequencies in the neighbourhood of 500 and 600. In the latter instrument a harmonic of frequency about 390 is most prominent in all three strings. In Japanese music as played, the scale consists of whole-tone intervals (9/8) combined with semitones which are variable. In the Gidayû-syamisen the semitone is much wider than in the Nagauta. It varies also with the player, the width often reaching a whole tone. It is pointed out that this is characteristic of Japanese music and is not due to faulty playing. G. E. A.

4329. Anomalous Propagation of Sound Waves at a Short Distance. T. Sakai. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 240–273, *July,* 1935. *In English.*—J. Kölzer has observed two cases of anomalous propagation of sound through the atmosphere, *viz.* (1) when the velocity of the sound increases linearly with the height and then reaches a constant value, a wave can be observed which arrives *before* the wave which travelled along the earth's surface, and (2) when the velocity decreases linearly with height and then reaches a constant value, there is a zone of silence succeeded by a region of audibility. Taking the case of two atmospheric strata and a cylindrical wave, the author shows that a wave in the upper medium is accompanied by another wave in the lower medium travelling along the surface of separation with the same speed. This wave is identified as the anomalous wave observed by Kölzer and should only appear when the distance between the source and the observer is greater than a certain critical value. By substituting probable values in the formulæ, results are obtained which agree with those observed by Kölzer. A phenomenon termed " multiple reflection shooting " is also predicted. J. E. R. C.

4330. Atmospheric Acoustics. L. Gutin. *Phys. Zeits. d. Sowjetunion*, 8. 1. *pp.* 71–80, 1935. *In German.*—The author examines the usual formulæ for the range of a source of sound, *e.g.*, a fog syren, and determines the modification necessary to allow for the diffraction of the wave by the earth's surface. The range of the direct ray is based upon a figure for the minimum audible sound field and the atmospheric absorption coefficient. The range of the wave diffracted by the earth's surface is more difficult to calculate. A simple approximate solution is found and shown to agree sufficiently well with the rigid solution. J. E. R. C.

4331. Stationary Ultrasonic Waves in Transparent Solids. E. Hiedemann and K. H. Hoesch. *Zeits. f. Physik*, 96. 3–4. *pp.* 268–272, *Aug.* 22, 1935.—Referring to an earlier paper [see Abstract 3956 (1935)] the authors recall that the lattice constant of an acoustic lattice can be measured directly with a higher accuracy than by observation of the diffracted optical spectra. A brief account is given of investigations of stationary ultrasonic waves in a glass block which is made to vibrate by an oscillating quartz crystal. The accuracy of measurement of the ultrasonic lattice constant is increased by examining the glass block in polarised light. The authors are led to believe that the different elastic vibrations can be distinguished by changing the plane of polarisation. J. E. R. C.

4332. Precision Determination of Elastic Constants of Transparent Bodies. E. Hiedemann. *Zeits. f. Physik*, 96. 3–4. *pp.* 273–276, *Aug.* 22, 1935.—By observing with natural and polarised light a glass block which is vibrating in a high natural mode, the wave-length of the longitudinal and transverse vibrations can be determined [see preceding Abstract]. Hence from a knowledge of the frequency the elastic constants can be determined. The method assumes that the vibrations under these conditions are the same as if the block were of infinite extent. Measurements made upon a glass block having known elastic constants justify this assumption. J. E. R. C.

4333. Absorption Coefficients of Some Materials. L. P. Varma. *Acad. Sci. Proc., U. P. India*, 4. 4. *pp.* 301–315, *May*, 1935.—A stationary wave method was used to determine the absorption coefficients at 512 ∼ of some commercial materials, an improved accuracy of measurement being claimed. Some values obtained are: ½″ thick felt, 0·278, ¼″ thick acoustic asbestos, 0·146. An embossed metal plate of the kind used for ceilings of auditoria, covered with two coats of a certain kind of paint, has the high value of 0·257. J. E. R. C.

4334. Absorption of Sound in Gases. H. O. Kneser. *Zeits. f. techn. Physik*, 16. 8. *pp.* 213–219, 1935.—A review of work on the absorption of sound in gases from the time of Kirchhoff up to the present. The failure of Kirchhoff's formula is due to the fact that the time required to establish thermal equilibrium is not small compared with frequency of the sound wave. Recent measurements in air, O_2, and CO_2 are in agreement with the theory of molecular absorption. The effect of foreign gases is discussed. A table of calculated values of the absorption coefficient in air is given for different temperatures and concentrations of impurity. J. E. R. C.

See also Abstract 4206.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4335. Determining the Condition of Balance in A.C. Bridges. A. van den Meersche. *Soc. Belge Élect., Bull.* 51. *pp.* 335–342, *July–Aug.,* 1935.—A mathematical investigation of various well-known a.c. bridges. Kirchhoff's and Maxwell's theories are quoted and the author's method is described. The bridge circuits analysed include Anderson's, Carey Foster's and Heaviside's. E. H. W. B.

***4336. Measurement of Small Capacities in Terms of Mutual Inductance and Resistance. W. H. Watson.** *Canad. J. of Research,* 13. *Sect. A. pp.* 5–9, *July,* 1935.—Campbell's a.c. bridge for the measurement of self-inductance in terms of mutual inductance can be modified so as to measure small capacities (1–1000 $\mu\mu$F). The arrangement described is sensitive to within 0·01 $\mu\mu$F. Small condensers can be measured to within 1% with ease. Residual errors are discussed. AUTHOR.

***4337. Exact Measurement of Electron-Tube Coefficients. R. W. Hickman and F. V. Hunt.** *Rev. Sci. Instruments,* 6. *pp.* 268–276, *Sept.,* 1935.—The analysis of the conventional bridge circuits for measuring electron-tube coefficients is extended to include the effect of grid current and tube and battery capacitances. The addition of an auxiliary capacitance bridge to the usual circuits permits annulment of the voltage quadrature component introduced into the detector circuit by the tube capacitances. In every case in which one or more of the tube capacitances form one arm of the auxiliary bridge the conditions of balance show the expression for the tube coefficient to be independent of the capacitances of the auxiliary bridge. If all the tube capacitances are considered a single balancing condenser in the auxiliary bridge gives an exact null balance, although the expression for the tube coefficient may contain a correction factor, usually negligible, involving the capacitances. This capacitance balancing method is applied to circuits for measuring both + and − values of the plate and grid coefficients, and the exact expressions for the coefficients are given under the general condition that electron current flows to both grid and plate. AUTHORS.

CONDUCTION AND DISCHARGE IN GASES.

4338. Variation of Ionisation with Pressure in a Gas Subject to Photon and Corpuscular Radiation. J. Clay. *Physica,* 2. *pp.* 811–816, *Aug.,* 1935. *In German.*—If p_0, p'_0 and p denote the greatest pressure for which the corpuscle will execute a rectilinear path in the gas, the greatest pressure for the corpuscle to reach the wall of the container and the actual pressure respectively, it is calculated that the ionisation due to photons is given by the relations $I = \frac{Ap^2}{p_0} + \frac{Bp}{p'_0}$, for $p < \frac{p_0}{p'_0}$; $I = Ap + \frac{Bp}{p'_0}$, for $p_0 < p < p_0$; and $I = Ap + B$ for $p > \frac{p_0}{p'_0}$ where A and B are constants. Good agreement is obtained with experiments (see following Abstract) using γ-rays in air up to 3 atmospheres and in hydrogen up to 18 atmospheres. Anomalous behaviour with argon subject to cosmic rays is attributed to a corpuscular component of the latter which requires the addition of an extra term Cp to the above formulæ. F. C. C.

4339. Determination of the Saturation Current on Jaffé's Theory of Positive-Column Ionisation. H. Zanstra. *Physica,* 2. pp. 817–825, *Aug.*, 1935. *In German.*—On the basis of Jaffé's theory of positive-column ionisation, a rapid means is given for estimating the saturation current from a few measurements in a moderate electric field (see preceding and following Abstracts). The utility of the method up to a pressure of 400 atomospheres is demonstrated with Erikson's measurements for air. F. C. C.

4340. Ionisation Measurements in Air at High Pressures. J. Clay and M. A. van Tijn. *Physica,* 2. *pp.* 825–832, *Aug.*, 1935. *In German.*—The ionisation produced by weak γ-radiation in air was examined in strong homogeneous electric fields up to 5000 V/cm. and up to pressures of 95 atmospheres. From Jaffé's theory of columnar ionisation together with calculations of Zanstra [see preceding Abstract] it is possible by linear extrapolation of a few results for fields above 800 V/cm. to determine the saturation current. The saturation value agrees with that deduced by Clay. If saturation is not reached the discharge potential depends on the polarity. At high pressures in air very high field strengths are required for saturation ; at 1 atmosphere saturation is not complete at 500 V/cm. No variation of ionisation with temperature was found between 20° and 30° C. F. C. C.

4341. Theory of Liquid Surface Rupture by a Uniform Electric Field. L. Tonks. *Phys. Rev.* 48. *pp.* 562–568, *Sept.* 15, 1935.—Surface distortion and rupture permits field emission from liquid surfaces at field strengths less than those effective for equally smooth solid surfaces. An approximate mathematical theory of the rupture of a plane liquid surface in a uniform electric field has been developed. Typically, the theory shows that a hump initially 4×10^{-5} cm. high and of diameter 9×10^{-4} cm. will lead to rupture in 5×10^{-6} sec. in a field of 10^{6} V cm.$^{-1}$. Relative to initial humps in the surface whose linear dimensions vary inversely as the square of the field, the time to rupture varies inversely as the cube of the field strength. This calculation shows that a lowered sparking potential to liquid Hg can be ascribed to surface rupture and shows that it is possible that surface rupture plays a part in Beams' low field emission from liquid Hg. Possible application of the theory to the high field condition at the kathode spot of the Hg arc is not clear. AUTHOR.

4342. Faraday Dark Space. K. G. Emeléus. *Roy. Irish Acad., Proc.* 42*A*. *pp.* 31–36, *July,* 1935.—Experiments are made with various forms of discharge tube containing 98 % He, and the results, together with those of other workers, afford qualitative support for assuming that while the Faraday dark space need not be traversed by fast electrons and diffusion due to electric field and concentration gradient can account for at least part of the conductivity, under some circumstances secondary effects due to short wave-length radiation from the negative glow may be of importance both electrically and optically. F. C. C.

4343. Dynamics of the Non-Stationary Gas Discharge. Part II. H. Gawehn and G. Valle. *Ann. d. Physik,* 23. 5. *pp.* 381–412, *Aug.*, 1935.—Continuing previous work [see Abstract 4661 (1934)], investigation is made of hysteresis phenomena as dynamical characteristics of the glow discharge in the rare gases. New methods are devised and rapidly disappearing secondary effects are examined and measured. Theoretical interpretation is based on the influence of the different simultaneous secondary effects on the dynamical characteristics. A technique is developed which allows the effect of slow hysteresis on the dynamics of the discharge to be examined on an oscillograph. In place of the normal statical characteristics, a series of quasi-statical characteristics is obtained. The rate of decay of the secondary effects was determined from the current-potential diagram, a distortion of which occurs in the form of an approximately plane parallel displacement. The quasi-statical characteristics of higher orders may be resolved in terms of the displacement of the diagram for a simple distortion and the dynamical characteristics for rapid discharges may be inferred from the accompanying quasi-statical characteristics. The effect of impressed oscillations on a stationary discharge is determined and finally intermittent discharges are examined. Moderately rapid to rapid secondary effects with decay velocities of 3×10^3 to 10^5 V/sec. were found. Different methods gave good agreement; photographic reproductions of many of the characteristics are given. F. C. C.

4344. Forms of the Anode-Glow Film in Hydrogen. E. Kiessling. *Zeits. f. Physik*, 96. 5–6. *pp.* 365–385, *Aug.* 31, 1935.—The nature and origins of the radially symmetrical star-shaped figures and spots developed at the anode in the anode glow in hydrogen are investigated experimentally and the results are discussed. The phenomena are interpreted in terms of the distribution of the field in the neighbourhood of the anode. J. S. G. T.

4345. Rate of Change of Electron Temperature in the Mercury Afterglow. R. H. Randall and H. W. Webb. *Phys. Rev.* 48. *pp.* 544–549, *Sept.* 15, 1935.—A study has been made of the behaviour of a plasma in which no new ions are found, as regards electron temperature and concentration, to determine the sources of the electron energy. Measurements were made with a movable probe in a stream of ionised mercury vapour passing out from an arc discharge. The rate of cooling of the electrons was very rapid at first, but below 2500° K. this rate decreased rapidly. Finally the electron temperature reached a constant value which was several hundred degrees above that of the vapour, the difference being proportional to the vapour concentration. The most reasonable source of energy necessary to keep up the electron temperature seems to be either the local recombination process, directly or through the metastable atoms formed, or the metastable atoms brought down the tube by the vapour stream. AUTHORS.

***4346. Mass-Spectrum Analysis of the Products of Ionisation by Electron Impact in N_2, C_2H_2, NO, CN and CO. J. T. Tate, P. T. Smith and A. L. Vaughan.** *Phys. Rev.* 48. *pp.* 525–531, *Sept.* 15, 1935. A mass spectrograph, designed for the identification of the products of ionisation and dissociation by electron impacts in molecular gases is described. A direct comparison in a nitrogen-argon mixture showed that the ionisation potential of nitrogen is at least 0·04 volt less than that of argon. The ionisation potential is therefore not greater than 15·65 volts, though it may be lower by as much as 0·1 volt. The ions formed by electron impacts in these gases together with their appearance potentials in volts are as follows :—

Ion	$C_2H_2^+$	C_2H^+	C_2^+	CH^+	C^+	H^+	
App. pot. ...	11·2	17·8	23·8	22·2	24·5	21·7,	25·6
Est. error ...	±0·1	±0·2	±0·3	±0·5	±1·0	±1·0	±1·0

Ion	NO^+	$N^{\cdot}$	NO^{++}	$C_2N_2^+$	C_2N^+	CN^+	C_2^+
App. pot. ...	9·5	22·0	44	14·1	19·8	21·3	18·6
Est. error ...	±0·1	±0·5	±1·0	±0·1	±0·5	±0·3	±0·5

Negative O^- ions appear in NO as reported by Tate and Smith. An ion of mass 27 found in C_2H_2 is ascribed to $C^{12}C^{13}H_2$. The abundance ratio $C^{13} : C^{12}$ was calculated to be 1 : 100. AUTHORS.

4347. Ionisation of Ne and A by Singly Charged Mg Ions. J. C. Mouzon and N. H. Smith. *Phys. Rev.* 48. *pp.* 420–422, *Sept.* 1, 1935.—The efficiency of ionisation (the number of electrons ejected per initial positive ion per cm. path per mm. pressure) by singly charged Mg ions is compared with that by singly charged Na ions to obtain further information on the parts played by mass and electron configuration in the ionisation process. The efficiency of the Mg ions is about 60 % of that of the Na ions in both gases. Data on the mean free path of Mg and Na ions in the two gases must be had before a quantitative comparison of the results can be made. If one assumes the mean free path of Mg ions to be greater than that of Na ions, the results indicate that the chance of ionisation on a single impact may be approximately the same for both ions. AUTHORS.

***4348. Device to Compensate for Magnetic Field Fluctuations in a Mass Spectrograph. A. O. Nier.** *Rev. Sci. Instruments,* 6. *pp.* 254–255, *Sept.,* 1935.—Fluctuations of the magnetic field of a mass spectrograph are used in conjunction with a valve amplifier to control the electric field so as to maintain the deflection of the ions at a constant value. This method of automatic compensation has the advantage that it is necessary to control only a very small amount of power. F. C. C.

***4349. Double Ionisation Chamber for the Detection of Corpuscular Particles. B. Zipprich.** *Zeits. f. Physik,* 96. 5–6. *pp.* 328–336, *Aug.* 31, 1935.—A double ionisation chamber is described which has only 0·3 mm. air equivalent per chamber, and whose chamber interval amounts to a minimum of 0·6 mm. The primary formed ions are reinforced in the homogeneous field by collision ionisation and thence conveyed to two duant-electrometers whose light indications are observed on a common registration strip. Full details of the method of measurement are included. The latter enables the range-groups of atomic fragments to be accurately recognised independently of yield fluctuation, and the range established. The mode of working of the double apparatus is clearly illustrated by an absorption curve and by diagrams of the registrations. H. H. Ho.

***4350. Wilson Cloud Chambers with an Increased Time of Sensitivity. J. A. Bearden.** *Rev. Sci. Instruments,* 6. *pp.* 256–259, *Sept.,* 1935.—Two types of sylphon-bellows Wilson cloud chambers have been constructed which have a time of sensitivity as great as 2·0 sec. This is accomplished by using a slow rate of expansion and an expanding space whose floor is water. The mechanical details are exceedingly simple and such that once the cloud chamber is adjusted it easily remains in adjustment indefinitely. About 4 to 5 cosmic-ray tracks appear for each expansion. A test with X-rays showed that the cloud chambers were sensitive for about 2 sec. under the best conditions. Some of the principal requirements for successful operation are listed. Also motion pictures of an expansion are reproduced. Several observations concerning the h.v. condenser—capillary tube method of illumination are given. AUTHOR.

***4351. High-Intensity Discharge Tube. D. S. Stevens.** *Rev. Sci. Instruments*, 6. *p.* 260, *Sept.*, 1935.—Simplification of the construction and operation of the discharge tube previously described [see Abstract 1233 (1935)].

***4352. Efficiency of Tube Counter. S. M. Skinner.** *Phys. Rev.* 48. *pp.* 438–447, *Sept.* 1, 1935.—The efficiency of counting ionising particles by the tube counter is investigated, taking account of the electrical behaviour of the counter and the random nature of the arrival of the particles. Expressions are obtained for the efficiency of counting, average recovery time, average voltage impulse delivered to the amplifier, and the average number of particles N per unit time in terms of the number of particles N_0 arriving per unit time, the time constant of the counter, and one other parameter *d*, which is constant for a given counter. Methods for measuring *d* (most counters between 1·3 and 5) are indicated. The efficiency of counting decreases with an increase of N_0, rapidly at first, then more slowly, so as to have the asymptotic value $1/d$. The determination of N_0 from N, and the general question of counter efficiency are discussed. AUTHOR.

See also Abstracts 4188, 4247, 4248, 4250, 4251, 4259, 4296, 4382, 4416.

CONDUCTION IN SOLIDS AND LIQUIDS.

***4353. Improved Precision Potentiometers. D. C. Gall.** *Journ. Sci. Instruments*, 12. *pp.* 284–285, *Sept.*, 1935.—In precision potentiometers there is usually a minimum residual potential above zero, which prevents the balancing of very small potentials. The method now used for overcoming this residual and allowing also small negative potentials to be balanced is described. AUTHOR.

***4354. Characteristics of D.C. Amplifier. P. A. Macdonald and W. E. Turnbull.** *Physics*, 6. *pp.* 304–307, *Sept.*, 1935.—The most suitable characteristics for steady deflection and electrometer use are discussed separately. For the former case it is shown that the mutual conductance may be increased three times the recognised value. When the valve is used as an electrometer a grid current as low as 10^{-17} A may be obtained with a voltage sensitivity of 10^{-4} V/division. The capacity of the grid system being only 3×10^{-12} F, a highly satisfactory electrometer results. AUTHORS.

***4355. Stability and Design of Manganin Resistances. E. H. Rayner.** *Journ. Sci. Instruments*, 12. *pp.* 294–297, *Sept.*, 1935.—It is shown that the stability of the resistance of manganin wire is largely dependent on freedom from strain. Variability in the resistance of wire covered with a layer of varnish, due to variations of atmospheric humidity causing change in the stress of the film of varnish, has been known previously. It is shown, however, that the effect is important in the case of resistances immersed in oil and sealed from the atmosphere; and methods of construction ensuring stability have been developed and are described. AUTHOR.

4356. Electron Theory of Supraconductivity. J. Stark. *Phys. Zeits.* 36. *pp.* 515–516, *Aug.* 1, 1935.—It is suggested that on the basis of an axial structure of their electromagnetic field free electrons can exert forces on one another and form a conglomeration or an " electron crystal " in which all their axes are parallel. In normal electric and thermal conduction in metals the electrons are free to move, while in the supraconducting state they become fixed and are constrained to move in groups as electron crystals. Based on these ideas a theory is put forward concerning the mechanism of supraconductivity. The supraconducting state in a given metal can only be produced below a definite temperature and the supraconductivity can be destroyed by a magnetic field or the transition temperature region between the ordinary and the supraconducting state can be lowered by it. The suggested explanation of the sudden change in the specific heat of a metal when passing through the transition temperature region in the direction of the lower temperature, is that the electrons become fixed axially in the electron crystal and can then vibrate about their position of rest. The frequency of this vibration is so small that only in the neighbourhood of the absolute zero does it involve a perceptible amount of thermal energy. The theory also offers an explanation of the thermoelectric behaviour of metals in the supraconducting state. The theory indicates that the transition temperature for a kinked (zig-zagged) wire would be lower than for a straight one, and that at the beginning of the supraconducting state the kinked wire should have the smaller resistance. Various indications of the theory were tested experimentally by **W. Meissner, K. Steiner** and **P. Grassmann,** accounts of which are given in a series of subsequent short papers (*ibid., pp.* 516–528) dealing with the effects of the size of crystal grain, and of the kinking of wires on the commencement of supraconductivity and the division of current between kinked and unkinked wires connected in parallel, at the commencement of supraconductivity, on the properties of supraconducting wires in magnetic fields and on the upper limit of ohmic resistance of supraconductors, and of the thermoelectric power between them. R. L.

4357. Supraconductivity of the Elements. Part III. Z. A. Epstein. *Zeits. f. Physik,* 96. 5–6. *pp.* 386–409, *Aug.* 31, 1935.—It is shown mathematically that the supraconducting state is a general property of the elements, which is attained by each element at a sufficiently low temperature. The abnormal character of Ga and the possibility of the occurrence of exceptions from the proposed rule regarding the incidence of supraconduction are discussed. [For Part II see Abstract 230 (1931).] J. S. G. T.

4358. Experiments at Very Low Temperatures Obtained by the Magnetic Method. Part II. Supraconductors. N. Kürti and F. Simon. *Roy. Soc., Proc.* 151*A. pp.* 610–623, *Oct.* 1, 1935.—The question of cooling down additional substances together with the paramagnetic salt by applying the magnetic method is discussed. The simplest way, namely, pressing the two substances into a pill, was used in the present investigation. It is shown how the measurement of the magnetic behaviour of a metal can be used for the detection of supraconductivity, and for finding the transition point and the threshold values. Three new supraconductors were found in the new temperature region, namely, cadmium, zirconium, and hafnium, the normal transition points being respectively 0·54°, 0·70°, and 0·35°. The samples of gold, copper, bismuth, magnesium and germanium did not become supraconductive down to 0·05°. [For Part I see Abstract 1719 (1935).] AUTHORS.

4359. Influence of Temperature on the Electrical Conductivity of Quartz. R. Radmanèche. *Comptes Rendus,* 201. *pp.* 448–449, *Aug.* 19, 1935.—The variation of conductivity of plates of quartz was studied as a function of the temperature. For feeble currents measurements were made by the method of the piezo-quartz ; for stronger currents the p.d. at the extremities of a resistance joined to a quadrant electrometer was measured. Measurements from 10^{-14} to 10^{-2} ampere were thus possible. For low temperatures the plate of quartz was suspended in a brass cylinder, which served as an electrostatic screen, and cooled by liquid air in a Dewar vessel. The current follows exactly the exponential law till –64°C., when it becomes too feeble to be measured. With high temperatures an increase of current was observed for an interval of 600° C. of the order of 10^6 times its initial value, but the exponential law ceases to be exact beyond 300° C. From this temperature the curve shows an elbow. About this same temperature the current in the inverse direction no longer exists when the p.d. is suppressed. J. J. S.

4360. Nature of Conduction in Solid Dielectrics. Part I. Electrolysis in Varnish Films. F. Quittner and W. Pruschinina. *Phys. Zeits. d. Sowjetunion,* 8. 1. *pp.* 41–58, 1935. *In German.*—By means of a titration method, it is shown that the conduction in bakelite and nitrocellulose varnish is purely electrolytic. Faraday's law and Poole's law for increase of conductance with voltage are found to hold. For bakelite varnish, conduction is entirely kationic and is due to metal and ammonia impurities in the varnish. Conduction in nitrocellulose varnish is bipolar, the transport numbers being $n^+ = 0 \cdot 3$ and $n^- = 0 \cdot 7$. Metallic salt impurities in nitrocellulose varnish lead to increased kationic conduction, but variation of the amounts of free acid and solvents has little effect. E. R.

See also Abstracts 4069, 4128, 4160, 4306, 4374, 4375, 4415.

DIELECTRICS AND CAPACITANCE.

4361. Measurement of Dielectric Constants of Solids by the Mixture Method. E. Kleinke. *Phys. Zeits.* 36. *pp.* 565–566, *Aug.* 15, 1935.—The measurement of the dielectric constants of solids by Starke's mixture method is very simple and accurate for small or moderate values, but for the high values possessed by such substances as rutile or Rochelle salt an extrapolatory process has to be used, and this is now described. A formula has been derived which is valid for homogeneous substances as well as for 2-layer media containing metals. In most cases the resonance method was used, but for rutile the suspension process was preferred.
H. H. Ho.

4362. Dielectric Constant of Water Vapour. J. D. Stranathan. *Phys. Rev.* 48. *pp.* 538–544, *Sept.* 15, 1935.—The frequently discussed deviations from linearity in the curves of $(K - 1)/(K + 2)$ *versus* pressure for water vapour have been investigated. It has been shown : (1) that the dielectric constant curves for the vapour are linear until saturation is approached closely ; (2) that neither pronounced breaks nor the small residual deviations always present near saturation are due to the conductivity effect as commonly supposed ; (3) that these breaks are due wholly to the added polarisation contributed by the film of water molecules adsorbed on the insulator surfaces. Accurate dielectric data have been obtained for water vapour at 14 temperatures ranging from 21·3° C. to 197·9° C.; they can be represented by the equation:—

$$[(K-1)/(K+2)]RT/p' = (4\cdot 03 \pm 0\cdot 39) + (20{,}710 \pm 140)/T.$$

These data fall accurately along a Debye line, yielding an electric moment of $(1\cdot 831 \pm 0\cdot 006) \times 10^{-18}$ e.s.u. for the water molecule. AUTHOR.

4363. Dipole Moments of Isotopic Molecules. R. P. Bell. *Faraday Soc., Trans.* 31. *pp.* 1345–1347, *Sept.*, 1935.—The observed dipole moment of a molecule will in general be a function of its amplitude of vibration, except in the case of a dipole composed of non-polarisable charges. There will in consequence be a difference in the dipole moments of isotopic molecules. Calculation on the basis of a simple model indicates that this difference may be detectable experimentally in the case of compounds of hydrogen and deuterium. AUTHOR.

4364. Dielectric Constants of Boron Compounds. M. M. Otto. *Am. Chem. Soc., J.* 57. *pp.* 1476–1478, *Aug.*, 1935.—Electric moments have been determined for butyl borate, amyl borate, phenylboric acid, *n*-amylboric acid and *n*-butylboric acid in benzene and dioxane solutions. Evidence is offered for non-association of the above boric acids in benzene and for the lack of compound formation between dioxane and these acids. Dioxane should serve as a good solvent for the determination of the moments of substituted phenylboric acids. AUTHOR.

4365. Polarisability and Related Properties of Molecular Hydrogen and the Diatomic Hydrogen Ion. J. O. Hirschfelder *J. Chem. Phys.* 3. *pp.* 555–556, *Sept.*, 1935.—The polarisability of molecular hydrogen is calculated from both the Rosen and Wang eigenfunctions by the variational method and similar results are obtained by both methods. The mean square dimensions and magnetic susceptibility are obtained. W. R. A.

4366. Dielectric Investigations on Nitromethane and Chloropicrin. C. P. Smyth and W. S. Walls. *J. Chem. Phys.* 3. *pp.* 557–559, *Sept.*, 1935.—The dielectric constants and densities of dilute solutions of nitromethane in heptane and of chloropicrin in heptane and in benzene have been measured and used to calculate the dipole moments of the solute molecules. The values thus calculated are considerably lower than those previously obtained in the gaseous state and are not well represented by the empirical equation of Müller. Measurement of the dielectric constant of pure liquid and solid nitromethane fails to show the existence of molecular rotation in the solid state. It is concluded, therefore, that the heavier molecule of chloropicrin does not rotate in the crystal. AUTHORS.

4367. Effect of the Kathode Material upon the Dielectric Strength of Rock-Salt. A. Worobjew. *Zeits. f. Physik*, 96. 1–2. *pp.* 148–150, *July* 25, 1935.—The dielectric strength of rock-salt (measured in respect of shock voltages of duration 5×10^{-4} sec.) is shown to depend upon the material of the kathode employed in the test. Results with kathodes of Hg, Na, Pb and a saturated aqueous solution of NaCl are given. Results obtained with the first and last of these materials were undistinguishable. The smaller the energy of ejection of electrons from the kathode the smaller the rupture voltage. J. S. G. T.

4368. Effect of Magnetic Field on the Dielectric Constant of Liquids. A. Piekara and M. Schérer. *Comptes Rendus*, 201. *pp.* 335–337, *July* 29, 1935.—The effect of the intensity of magnetic field on the dielectric constant of a number of liquids was studied with a large electromagnet and the results are given graphically. They are of the form

$\Delta\epsilon = AH^2 + BH^4$ where A and B are characteristic constants and H is the field in gauss. For the extreme cases benzene gave $A = 0$ $B = 3 \times 10^{-22}$ and nitrobenzene $A = 10^{-11}$ and B nearly zero. For benzene and chloroform the increase of dielectric constant under the action of a field of 50 kgauss is independent of wave-length for $\lambda = 500 \sim 1500$ m., within the limits of experimental error. The effect of the change of angle between the electric and the magnetic fields was very small, but the authors established that for parallel and perpendicular fields the change of dielectric constant was + and of the same order of magnitude for the substances tested. R. L.

See also Abstracts **4052, 4082, 4222, 4336.**

ELECTROCHEMISTRY.

4369. Dependence of Diffusion Potentials on Concentration. Part I. Z. Szabó. *Zeits. f. phys. Chem.* 174. *Abt.A.* 1. *pp.* 33–40, 1935.—The dependence of certain diffusion potentials on the concentration has been investigated with the help of liquid elements with two identical electrodes, *e.g.*, Hg | HgCl, *a* mol. HCl | *x* mol. HCl | *b* mol. KCl | *a* mol. HCl, HgCl | Hg. Between solutions of an electrolyte of different concentrations, the diffusion potential is constant, reproducible and independent of the nature of the transference layer. The principle of superposition is strictly valid. To obtain constant and reproducible diffusion potentials between solutions of different electrolytes, the transference layer must possess cylindrical symmetry. The sum of the diffusion potentials in the above cells is a linear function of the logarithm of the concentration of the hydrogen chloride up to 0·5 mol. T. H. P.

4370. Hardness of Electrolytic Chromium and the Influence of the H_2 in the Metal. S. P. Makariewa and N. D. Birükoff. *Zeits. f. Elektrochem.* 41. *pp.* 623–631, *Aug.*, 1935.—The separation of H_2 from electrolytic Cr at temperatures between 20° and 650° C. has been investigated. The hardness of the metal does not depend on the quantity of H_2 it contains. When, however, the Cr is heated to 200° C. and 30 % of the H_2 is removed, the hardness increases. This is explained by the conversion of the hexagonal lattice of the softer Cr into a cubic (face-centred) lattice of the harder form. When 98 % of the total H_2 is expelled by heating to 575° C., the increased hardness is maintained. At 575° ± 20° C., after all the H_2 has been evolved, the hardness falls appreciably. This temperature is evidently a critical one as regards the disappearance of internal elastic tensions in the lattice and the recrystallisation of the metal. T. H. P.

4371. Electrolytic Preparation of Thin Layers of U_3O_8. M. Francis. *Comptes Rendus*, 201. *pp.* 473–474, *Aug.* 26, 1935.—Referring to a previous paper [see Abstract 2241 (1935)] in which is described an electrolytic method of preparing thin layers of U_3O_8 which would serve as standards, it is reported that unless the deposition is carried through with a carefully purified solution other radioactive bodies will also be deposited. J. E. R. C.

4372. Unusual Modes of Ionic Migration. D. Kreichgauer and F. Mönch. *Zeits. f. Physik*, 96. 1–2. *pp.* 107–116, *July* 25, 1935.—When a current flows through a solution of a metallic salt ($Zn\ SO_4$), the metallic ions sometimes accept the entire conductivity mechanism in that they alone migrate, whereas the more strongly impeded (non-displaceable) acid ions (SO_4) remain stationary. This latter condition, however, is labile, and in the case of Zn salts of moderate concentration lasts from about 2 to 25 min. before the normal two-directional migration periods. As soon as the latter begins, a strong dilution of the solution in contact with the kathode arises (through migration of both ions, together with an accompanying rapid increase of resistance. The duration of the labile state is prolonged by small current densities, high concentrations and rise of temperature. The latent water of crystallisation, which adheres to any form of ion, appears to favour the lability, prolongs the initiation of anionic migration and often delays it considerably. The resistance of salt solutions decreases with increase of current density, and thereby the validity of Ohm's law is difficult to recognise in these solutions. Addition of gelatin to a salt solution increases the influence of current strength upon conductivity. H. H. Ho.

4373. Ionic Activities of Hydrochloric Acid. Z. Szabó. *Zeits. f. phys. Chem.* 174. *Abt.A.* 1. *pp.* 22–32, 1935.—Ionic activities may be determined from the e.m.f. of liquid elements with transport, provided that the diffusion potentials are known sufficiently accurately. These potentials may be ascertained as follows. If f_1 and f_2 are the ion-activity coefficients at concentrations m_1 and m_2, γ_1 and γ_2 the corresponding mean activity coefficients and ϵ the diffusion potential, then the observed e.m.f., E_g, of the HCl concentration element is $(RT/F)\log_e(f_1m_1/f_2m_2)+\epsilon=E_g$. A fictitious e.m.f., E_b, is defined by the equation $(RT/F)\log_e(\gamma_1m_1/\gamma_2m_2) = E_b$. The values of $E_g - E_b$ are a linear function of log m up to the concentration 0·2 mol. The inclination of the straight line $E_g - E_b = F(\log m)$ is exactly equal to that of $\epsilon = (E_g + E_g^1)/2 = f(\log m)$ – where E_g is the e.m.f. of the kation element and E_g^1 that of the anion element—which gives the diffusion potentials, at any rate for very high dilutions. The potentials between differently concentrated HCl solutions, determined in this way, differ by about 3 % from the calculated values. The ionic activity coefficients are equal to one another and to the mean activity coefficients for concentrations up to 0·2 mol. T. H. P.

4374. Mechanism of Ionic Motion in Solid Electrolytes. W. Schottky. *Zeits. f. phys. Chem.* 29. *Abt.B.* 5. *pp.* 335–355, 1935.—The method employed by Jost [see Abstract 3762 (1933)] in calculating the absolute value of the vacant spaces in the lattice is regarded as insufficiently accurate. From a consideration of the data available, the following qualitative conclusions are drawn. In the lattices of the (non-activated) alkaline earth oxides, the mechanism of the ionic conductivity must be regarded as purely a mechanism of the vacant spaces. The relatively small difference between the anion and kation conductivities established for the alkali halides need not depend on a difference in numbers but may be determined by different mobilities of the ionic spaces of the two kinds. With the alkali halides increase in the vapour pressure of the metallic component must result firstly in diminution, but at high vapour pressures in increase, of the total value of the electrolytic conductivity. T. H. P.

4375. Electrolytic Transference of Carbon in Hard Steel. W. Seith and O. Kubaschewski. *Zeits. f. Elektrochem.* 41. *pp.* 551–557; *Disc.*, 558, *Aug.*, 1935.—The research is to throw light on the nature of metallic linkage by investigating the electrolytic transference of carbon in steel. Both a.c. and d.c. experiments were made and it was found that in an iron wire heated to 1070° C. with d.c. the speed of diffusion of the carbon depends on the direction of the current. The effect can be followed quantitatively by conductivity measurements of individual sections and made visible by etching. Full experimental details are given of the preparation of the wire and the conductivity measurements. Calculations of the ionic mobility by two different methods gave 1·6 and $2 \cdot 2 \times 10^{-5}$ cm./sec.V. R. L.

***4376. Antimony Electrodes for pH Measurements. P. Wulff, W. Kordatzki and W. Ehrenberg.** *Zeits. f. Elektrochem.* 41. *pp.* 542–549; *Disc.*, 550–551, *Aug.*, 1935.—The experiments were carried out on the irreversible electrode system $Sb + O_2 + H^+ aq$. The potential values were determined in presence of air since an air free Sb electrode has no practical advantage over electrodes in common use. The experiments show a complicated mechanism for the formation of O_2 reduction and Sb oxidation products which depends on the character of the solution, the pH value, stirring and diffusion, and on the nature of the surfaces. The Sb electrode is subjected to a slow oxidation process which produces 3- and 5-valent Sb. A reaction product separates on the surface of the metal and this influences the potential, as also does the partial pressure of O_2 and, under certain conditions, the movement of the electrolyte. These relations, especially the quantitative ones, show that in presence of air the potential cannot be determined by the Sb^{+++} activity of the solution, but by the irreversible oxidation process, and that the speed of diffusion of the reaction products must be considered at the electrode surfaces. Some hints are given for the practical employment of Sb electrodes. R. L.

***4377. Glass Electrodes for pH Measurements. K. Schwabe.** *Zeits. f. Elektrochem.* 41. *pp.* 681–694, *Sept.*, 1935.—The paper gives a comprehensive survey of the field covered by the employment of glass electrodes for pH measurements from Nernst until the present day. It deals with the various aspects of the problem including the form of the electrodes, the technique of measurement, the electrode functions and their uses. A long Bibliography is appended. R. L.

4378. Potential Vibrations of Iron in Nitric Acid. Part II. M. Karschulin. *Zeits. f. Elektrochem.* 41. *pp.* 664–667, *Sept.*, 1935.—The red-brown layer, which forms upon the surface of iron, that periodically goes into solution in nitric acid [see Abstract 2245 (1935)] has been spectrographically investigated; the absorption spectrum is found to be identical with the absorption of light given by a solution of ferrous nitric oxide nitrate, $Fe(NO)(NO_3)_2$. Based on the results now recorded it is concluded that in systems: metal-acid, in which the formation of a metallic NO compound is possible, periodic solution phenomena can occur. H. H. Ho.

See also Abstracts 4046, 4159, 4360.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4379. Theory of Elementary Particles. Part I. N. S. Japolsky. *Phil. Mag.* 20. *pp.* 417–468, *Sept.*, 1935.—An attempt is made to construct models of the elementary particles in the form of systems of rotating cylindrical electromagnetic waves termed "whirls," in free space. It is shown on the basis of classical electrodynamics, that whirls, to be stable, must satisfy the postulates of the theory of relativity and of quantum and wave mechanics. Electrons and protons are considered as electropolarised whirls, positrons and light quanta as magnetopolarised whirls. Gravitation is explained by the interaction of contrapolarised whirls. It is contended that with the aid of the theory, the postulates of wave mechanics and of the principle of relativity can be explained on the basis of Maxwell's equations. F. C. C.

4380. Velocity Distribution of Electrons in a Gas under the Action of an Electric Field. B. Davydov. *Phys. Zeits. d. Sowjetunion,* 8. 1. *pp.* 59–70, 1935. *In German.*—The distribution of velocity among electrons in a gas under the action of an electric field is calculated for the restricted case of elastic collisions between electrons and gas molecules. Expressions for the mean energy and mean velocity of the electrons are also found. The velocity distribution of the molecules remains Maxwellian. F. C. C.

4381. Total Scattering of Electrons in He. A. L. Hughes and W. Harris. *Phys. Rev.* 48. *pp.* 408–411, *Sept.* 1, 1935.—The total electron scattering—defined as the sum of the elastically scattered electrons and all the inelastically scattered electrons—in He has been measured for electron energies between 1000 and 200 V. The results are compared with the theoretical values given by Morse's formula. According to the formula, the scattering in He should be given by $(1/\mu^4)$ $[Z^2(1 - F)^2 + Z(1 - F^2)]$, where Z is the atomic number (here $= 2$), F the atom form factor, and $\mu = \sin(\theta/2)/\lambda$ in which θ is the angle of scattering and λ the wave-length of the associated electron waves. Theory and experiment agree well at 1000 and 700 V. At 500 V there is a slight discrepancy which increases down to 200 V. AUTHORS.

***4382. Elastic and Inelastic Cross-Sections of the Mercury Atom. F. L. Arnot and G. O. Baines.** *Roy. Soc., Proc.* 151*A.* *pp.* 256–274, *Sept.* 2, 1935.—A new apparatus and method described for measuring elastic and inelastic cross-sections of atoms. Measurements have been made of the elastic and inelastic cross-sections of the mercury atom, including the ionisation function and the excitation functions for the $2\,^3P_1$ (4·86 V), $2\,^1P_1$ (6·67 V), and $3\,^1D_2$ (8·8 V) states. The range of electron energy was from 4 to 180 V. The maximum at 35 V found by Brode in the total cross-section does not appear in the elastic cross-section, which shows a monotonic decrease with increasing electron energy. The excitation function for the $2\,^3P_1$ state agrees well with Penney's theoretical curve, and shows the fairly high constant probability of excitation without electron exchange over the energy range of 20 to 40 V. The excitation function for the $2\,^3P_1$ state reaches a maximum of 14·6 cm.^{2}/cm.^{3} at 7 V, that for the $2\,^1P_1$ state has a broad maximum of 15 cm.^{2}/cm.^{3} at about 15 V. The curve for the $3\,^1D_2$ state reaches a fairly sharp maximum at 15 V. AUTHOR.

4383. Velocity Distributions for Elastically Colliding Electrons. P. M. Morse, W. P. Allis and E. S. Lamar. *Phys. Rev.* 48. *pp.* 412–419, *Sept.* 1, 1935.—The distribution function for the velocity of electrons in a gas is determined by two equations which correspond to the detailed balancing of energy and momentum, and take into account the variation of collision cross-section with velocity. The kinetic energy ϵ of the electrons is supposed to be larger than that of the gas atoms, yet small enough so that the majority of the energy lost is by elastic collisions with the atoms. For electrons in a uniform electric field, the distribution function is proportional to $\exp(-\epsilon^2/a^2)$, instead of to $\exp(-\epsilon/a)$, as for Maxwellian distribution. For a homogeneous beam of electrons of energy ϵ_0, shot into a field-free space, where they lose energy to the gas atoms by collisions, the distribution function depends on z, the distance along the beam in mean free paths, and on t, the average number of collisions the electron has had before its energy decreases from ϵ_0 to ϵ. This distribution is also non-Maxwellian but depends on a solution of an equation in z and t having the form of the heat flow equation. The solution has been tested experimentally and a quantitative check is obtained. F. C. C.

4384. Polarisation of Electron Waves by Scattering. H. Hellmann. *Zeits. f. Physik*, 96. 3–4. *pp.* 247–250, *Aug.* 22, 1935.—Theoretical arguments are marshalled to explain the negative experiments on the polarisation of electron waves by surfaces of uniform potential. F. C. C.

4385. Production of Electron-Optical Images with Photoelectrons. H. Mahl and J. Pohl. *Zeits. f. techn. Physik*, 16. 8. *pp.* 219–221, 1935.—Electron-optical images are formed with the electrons liberated photoelectrically from a variety of surfaces. It is found that images of non-metallic conductors as well as of metals can be obtained, that even in the presence of small irregularities on the kathode surfaces the production of sharp pictures is possible and that the purity and other properties of the surface are readily noticeable in the electron pictures. The method is applied to an investigation of melting metals, of photoemissive layers variously treated and to the photography of mineral surfaces. J. E. K.

4386. Potential Distributions of Slit and Hole Diaphragms. A. Glaser and W. Henneberg. *Zeits. f. techn. Physik*, 16. 8. *pp.* 222–230, 1935.—In continuation of previous papers by the same authors [see Abstracts 689 (1933) and 2267 (1935)] the potential distributions in the neighbourhood of slits and circular holes in plane diaphragms are further investigated both theoretically and experimentally. J. E. K.

***4387. Chromatic Errors of Electron-Optical Systems. W. Henneberg and A. Recknagel.** *Zeits. f. techn. Physik*, 16. 8. *pp.* 230–235, 1935.—The influence of chromatic errors on the picture quality produced by various electron-optical systems is investigated theoretically. The results are applied to systems for producing electron images of light pictures. It is shown that focusing arrangements provide better quality of picture than a pure accelerating field although in the latter case the distance from object to receiving screen is smaller than in the former case. Comparison of focusing systems shows that the single lens is capable of giving the best quality. J. E. K.

See also Abstracts 4073, 4074, 4301.

ELECTROSTATICS.

4388. Electrical Distribution on Circular Cylinders. E. P. Adams. *Am. Phil. Soc., Proc.* 75. *pp.* 11–70, *May*, 1935.—A mathematical investigation of the problem of determining the electrical distribution on two infinitely long circular cylinders under various conditions of relationship, *e.g.*, concentric; in contact; apart at different angles and in different planes, etc.; equal and unequal cylinders and other combinations. Schwarz-Christoffel transformations are made use of as well as other methods. E. H. W. B.

4389. Volta and Peltier Effects. F. Odone. *N. Cimento*, 12. *pp.* 273–284, *May*, 1935.—Based on the thermodynamic theory of electric phenomena in metallic conductors, a theory developed by Duhem, proof is given of the existence of an external and an internal Volta effect, of a p.d. between the interior and the surface of a metal, and of the Peltier effect. The relations between these various effects are found. It is explained why the coefficient of the Peltier effect does not measure the p.d. of contact. The Peltier heat is the thermal equivalent not of all the work corresponding to the actions of the material masses on the electric charges, but is the thermal equivalent only of the compensated work of these actions. The theory given is compared with those commonly held. J. J. S.

***4390. Van de Graaff Electrostatic Generator. R. G. Herb, D. B. Parkinson and D. W. Kerst.** *Rev. Sci. Instruments,* 6. *pp.* 261–265, *Sept.,* 1935.—An electrostatic generator of the van de Graaff type has been developed which operates in a large steel tank under an air pressure up to 45 lb. The maximum steady voltage obtained was about 750 kV. In applying this voltage to an evacuated tube for acceleration of protons the usable voltage is limited by the dimensions of the present tube to about 400 kV. The apparatus has given satisfactory service during a year of use in nuclear disintegration work. AUTHORS.

See also Abstract 4386.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4391. Thermomagnetic Study of Some Cerous Salts. (Miss) A. Serres. *J. de Physique et le Radium,* 6. *pp.* 336–339, *Aug.,* 1935.—Using the method previously described [see Abstract 833 (1934)], the following data were obtained for the magnetic moment *n*, and the Curie point θ of the highly purified chloride, nitrate, and oxalate of cerium investigated over a temperature range of about 200°. $CeCl_3$, $n = 12\cdot45 \pm 0\cdot05$, $\theta = -22\cdot9°$ Abs.; $Ce(NO_3)_3\cdot5H_2O$, $n = 11\cdot9 \pm 0\cdot1$, $\theta = -16\cdot7°$ Abs.; $Ce_2(C_2O_4)_3\cdot2H_2O$, $n = 12\cdot47 \pm 0\cdot05$, $\theta = -44\cdot0°$ Abs. The results obtained satisfied the Weiss law $\psi(T - \theta) = C$. N. M. B.

See also Abstract 4300.

MAGNETISM AND ELECTROMAGNETISM.

4392. Demagnetising Factor of Cylindrical Rods. T. Nishina. *Tohoku Univ. Sci. Reports,* 24. *pp.* 254–263, *July,* 1935. *In English.*—The demagnetising factor of cylindrical rods of ferromagnetic substances was determined in a very weak magnetic field by the magnetometric and ballistic methods. The factor was found to depend on dimension ratio, diameter and also on the magnetic properties of the materials. AUTHOR.

***4393. Magnetometric Measurement of Susceptibility of Ferromagnetic Powders. D. P. Raychaudhuri.** *Indian Journ. Phys.* 9. *pp.* 417–424, *July,* 1935.—A description of a convenient magnetometric method for the measurement of the susceptibility of ferromagnetic powders. The results of measurements on some ferrites are also given. Under certain circumstances the phenomenon of magnetic viscosity is observed for nickel ferrite. AUTHOR.

4394. Formation and Magnetic Properties of Ferrites. D. P. Raychaudhuri. *Indian Journ. Phys.* 9. *pp.* 425–432, *July,* 1935.—It is shown that the magnetic properties of ferrites depend largely on their method of preparation. For the dry method the deciding factors are the duration of heating and the temperature. This leads to the clearing of the disagreements among different observers. Some magnetic data are given for a number of ferrites. AUTHOR.

4395. Mapping of Magnetic Field of Nickel Crystals. S. Kaya and J. Sekiya. *Zeits. f. Physik*, 96. 1–2. *pp.* 53–61, *July* 25, 1935.—Three discs, 20 mm. dia. and 5 mm. thick were cut from a mass of nickel crystals and polished in a vacuum for 6 hr. at 600° C.; the effects of polishing were removed by washing for 30 min. in a 30 % solution of H_2O_2 and HNO_3. Extending previous work [see Abstract 4726 (1934)], the magnetic field on the surface of nickel crystals was examined. For both cubic and dodecahedral faces the direction of magnetisation was confined to the tetragonal axis. As with iron, until saturation is reached, very little magnetic force is experienced along the trigonal axis. Many photographic reproductions exhibit the effects. F. C. C.

4396. Composition and Magnetic Characteristics of Pt/Fe Alloys. L. Graf and A. Kussmann. *Phys. Zeits.* 36. *pp.* 544–551, *Aug.* 15, 1935. *From the Reichsanstalt.*—An experimental investigation of the magnetic properties of Fe/Pt alloys in relation to composition and structure. After X-ray and microscopic study the following details give the results: on the Fe side of the system the saturation value of the magnetisation with increasing addition of Pt is lowered gradually to about 10 % above the value for pure α-Fe, and then through the influence of cubical form sinks further to the γ-crystallisation form. The lattice structure of the α-phase cannot be clearly established. At about 26 % Pt the alloy at room-temperature is fully composed of γ-crystals and is no longer ferromagnetic. Between 30 and 70 % Pt the alloys of Fe/Pt show a strongly ferromagnetic range once more with a saturation value of 14,000 ($4\pi J_\infty$) and a Curie point of 450° C. The result is interpreted in terms of crystal structure. At this range of composition the hysteresis curves show an extraordinarily great breadth with a coercive force of 1800 gauss and a remanence of 3000 to 4000 C.G.S. Thereby is found the highest known value of the energy content (magnetic). This is again attributed to the peculiar lattice structure of the mixed crystals. Full practical details are given. S. G. B.

4397. Magnetism and the Electronic State of Metallic Mixed Crystals and Elements. U. Dehlinger. *Zeits. f. Elektrochem.* 41. *pp.* 657–659, *Sept.*, 1935.—The experimentally found magnetic saturation moments for Co, Ni, Cu and their mixed crystals, differ from the theoretically expected values for the ions Co^+, Ni^+ and Cu^+ (namely 2, 1, 0 Bohr magnetons per atom) by an only slightly variable amount of about 0·3 Bohr magneton. This approximately independent depression of the moment by the separate body moments is traced to a partial saturation of the body moment by the moment of the surrounding electronic gas; this may be theoretically established. For Fe, and for mixed crystals rich in Fe, the depression is essentially greater, and this may be traced, by taking into consideration the magnetic difference between α- and γ-Fe, to the fact that with Fe (and perhaps also with Mn) the reciprocal effect of the neighbouring higher spheres may bring about ferromagnetism; here also a partial mutual saturation of the atomic bodies may be present.

H. H. Ho.

4398. Ferromagnetism and Small Field Changes. R. Gans and H. Wittke. *Ann. d. Physik*, 23. 5. *pp.* 459–464, *Aug.*, 1935.—A recent paper by Jordan [see Abstract 896 (1935)] is criticised, particularly with regard to the interpretation of the results. Evidence is adduced from the work of the authors and others to support the criticism and to urge the need for further study. H. J. H. S.

4399. Propagation of Large Barkhausen Discontinuities. Part V. Magnetic Reversal Nuclei. K. J. Sixtus. *Phys. Rev.* 48. *pp.* 425–430, *Sept.* 1, 1935.—In a Ni-Fe wire, having a preferred direction of magnetisation produced by tension, stable regions of antisaturated magnetisation can be produced by short application of high local fields. These nucleus regions will not grow after removal of the local field, though the external field favours growth, because their demagnetising field lowers the total field in the neighbourhood below the value H_o, the minimum field value at which propagation would proceed spontaneously. Propagation will start from a nucleus region if the external field is raised to a value $H_{s'}$, where $H_{s'} = H_o + H_d$, H_d being the demagnetising field of the nucleus, calculated from its dimensions. A natural nucleus in a stressed wire was found to have a length of a few mm. and a diameter of several μ. [For Part IV see Abstract 3820 (1933).] J. J. S.

4400. Heat Treatment of Magnetic Materials in a Magnetic Field. Parts I and II. J. F. Dillinger and R. M. Bozorth. *Physics*, 6. *pp.* 279–291, *Sept.*, 1935.—Part I. The effect of heat treatment on the magnetic properties of Fe-Ni-Co alloys in a magnetic field is investigated for a number of these alloys. A maximum change for the Fe-Ni alloys occurs between 65 and 70 % Ni, when a large increase in maximum permeability is observed, together with a hysteresis loop of rectangular shape. All the alloys with Curie points above 500° C. and with no phase transformations have their properties similarly changed. Prolonged preliminary annealing in the field enhances this change and in the case of permalloy (65 % Ni), after annealing for 18 hr. at 1400° C., a maximum permeability of 6×10^5 has been obtained. The magnetic properties of alloys treated in this way appear to be insensitive to stress, but at the same time they are highly anisotropic; in some cases the maximum permeability in one direction may be 150 times as great as in that at right angles. Part II. The nature of the changes occurring in the maximum permeability by thermal treatment is studied in more detail for 2 alloys, one containing 35 % Fe and 65 % Ni (permalloy) and the other 20 % Fe, 60 % Co and 20 % Ni (perminvar). These alloys, if heat treated in a field of 10 G. at temperatures above 400° C., but below the Curie point, show a large increase in maximum permeability. The time during which the magnetic properties change is measured at different temperatures and is found to follow the law $\tau = Ae^{W/kT}$, where A is 10^{-12} sec. and W is 2·1 electron volts, values which are in agreement with those previously derived by Bragg and Williams. An interpretation of the results is given in terms of the domain theory of ferromagnetism and it is suggested that the changes which occur are due to the relief of magnetostrictive stresses which arise when the material becomes ferromagnetic on cooling through the Curie point or when an external field is applied, the relief coming about by plastic flow or diffusion in the separate domains. H. J. H. S.

4401. Diamagnetism of the Thomas-Fermi Ion. T. Hirone. *Tohoku Univ. Sci. Reports*, 24. *pp.* 264–267, *July*, 1935. *In English.*—The diamagnetic susceptibility of the Thomas-Fermi ion, a model of the metallic ion, is calculated as a function of the atomic number and valency of the ion. The experimental results upon the susceptibilities of alkali and alkali-earth metal ions, which are not explained satisfactorily by Sommerfeld's previous calculation [see Abstract 95 (1933)], are in good agreement with the present theory. AUTHOR.

4402. Diamagnetism of the Dirac Electron. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 580, *pp.* 109–115, *Aug.*, 1935. *In English.*—Mathematical. In a previous paper [see Abstract 4722 (1934)] it was shown that the diamagnetic susceptibility of the electron can be derived from the exact linear equation of Dirac under the assumption that the field strength is weak and kT small compared with the doublet separation (k is Boltzmann's constant). Taking the case of a magnetic field that is strong compared with the doublet separation, it is shown that the relativistic expression for the diamagnetic susceptibility is the same for a strong field as for a weak one. G. E. A.

4403. Diamagnetic Properties of Inorganic Compounds in Aqueous Solution and in the Solid State. M. Flordal and O. E. Frivold. *Ann. d. Physik,* 23. 5. *pp.* 425–430, *Aug.*, 1935.—LiCl, LcBr, NaCl, KF, KCl, KBr, KI, $CaCl_2$, $CaBr_2$, $ZnCl_2$, $SrCl_2$, $CaBr_2$, $BaCl_2$ and $K_4Fe(CN)_6$ have been examined in aqueous solution and in the crystalline state. The susceptibility of the solution is greater than of the crystals; in uni-univalent salts and in $ZnCl_2$ the difference does not exceed the experimental error, whereas with the other salts the difference is outside the limits of experimental error. The non-addivity of diamagnetism is deduced. W. R. A.

4404. Molecular Susceptibilities of Certain Diamagnetic Compounds in Different Solvents. O. E. Frivold and H. Sogn. *Ann. d. Physik,* 23. 5. *pp.* 413–424, *Aug.*, 1935.—Results for aqueous and alcoholic solutions of LiCl, LiBr, $CaCl_2$, $CaBr_2$, $SrBr_2$, $NaClO_4$, $Ca(NO)_3$ and for aqueous and acetone solutions of $NcClO_4$, $Ca(NO_3)_2$ and $Ba(ClO_4)_2$ are recorded. The molecular susceptibilities in water are in most cases higher than in the organic solvent. The magnetic properties of these compounds are not strictly additive. W. R. A.

4405. Magnetic Behaviour of Supraconducting Tin Spheres. K. Mendelssohn and J. D. Babbitt. *Roy. Soc., Proc.* 151*A*. *pp.* 316–333, *Sept.* 2, 1935.—The magnetic field in the neighbourhood of supraconducting tin spheres is investigated by two different methods. It appears that the induction in a supraconducting tin sphere is only zero when it has been cooled in zero magnetic field and the threshold value is not surpassed in any part of the sphere. In all cases where supraconductivity sets in while an external magnetic field is established, part of the magnetic flux remains in the specimen and the total induction never becomes zero. These processes are investigated and the results are discussed in detail. It is found that this "freezing in" of part of the flux gives rise to a magnetic hysteresis phenomenon which may be related to the hysteresis observed in conductivity. The percentage of "frozen in" flux is greater in a hollow than in a solid sphere. AUTHORS.

4406. Form and Symmetry of the Electromagnetic Equations; Equivalence of Energy and Mass. J. Urbanek. *Comptes Rendus,* 200. *pp.* 2067–2070, *June* 17, 1935.—It is shown that complete symmetry between the magnetic and electric magnitudes, such that they occur symmetrically in the electromagnetic equations and corresponding magnitudes have the same dimensions, is attained in a system in which the complete equivalence of energy and mass is recognised. This result follows by equating the dimensions of energy and mass. A further consequence is that the number of fundamental dimensions is reduced from 3 to 2 in mechanics and from 4 to 2 in electricity. W. S. S.

4407. Magnetic "After Effect" or Remanence. H. Wittke. *Ann. d. Physik*, 23. 5. *pp.* 442–458, *Aug.*, 1935.—Magnetic "after-effect" or remanence has been studied by a number of investigators. The present treatise after reviewing previous work is designed to study experimentally by means of a pendulum switch, the ballistic phenomena in iron rings, etc., in particular the time-lag or the difference of the value $\eta = B - B_\infty$ up to the point where it has but 1/100th of its initial value. Experimental details are given. The results indicate that the whole can be written according to the equation $\eta = C_1 e^{-\alpha t} + C_2 e^{-\beta t} + C_3 e^{-\gamma t}$. Of the three components $C_1 e^{-\alpha t}$ is the main or chief function and represents the magnetically reversible part of the procedure, and $C_2 e^{-\beta t}$ (with $\beta = 2\alpha$) is the hysteresis part. This disturbing function gives the Rayleigh loss. The last component $C_3 e^{-\gamma t}$ is the free "after effect." The results show that each switch or commutator operation has an effect independent of the previous history of the material and depends only on the exponential function determined by the material constants themselves. The exponent γ (Fe 6·6 and steel 8·4) is independent of the velocity of the speed of alteration of the field. The free effects and phenomena represented by this exponential function, which remains superfluous after make or break, is regarded as "after effect" in the true sense of the word. It is a characteristic of the material itself and not of the time-lag of the field. It exists long after the field is forgotten. "After effect" only allows the end conditions to be assumed slowly. S. G. B.

***4408. Magnetostriction Vibrations. B. Gurewitch.** *Comptes Rendus*, 201. *pp.* 387–389, *Aug.* 5, 1935.—A description of a new apparatus for the study of magnetostriction. The design utilises the Schulze method modified, whereby the elongations of a bar 3 to 4 mm. thick are, as they alternate, made to produce as in an electric microphone, a modulation of low frequency in a h.f. oscillating circuit. One end of the bar is attached to an armature of the condenser which is registering the oscillations and this light armature (a copper disc 0·2 mm. dia.) is attached to the bar in such a way as to be orientated at right angles to it. Details of manufacture and structure of the apparatus are given fully. S. G. B.

***4409. Intensity Measurement of E.H.F. Magnetic Fields. M. Divilkovskij and M. Filippov.** *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 521–527, *June*, 1935. *In French.*—Details, experimental and theoretical, are given of a method devised to measure the intensity of magnetic fields of period about 10^{-7} sec., the frequency of oscillation being derived from a lamp circuit giving a wave-length of about 4·10 m. Current measurement and magnetic intensity determinations are quite independent and assessed directly. The intensity of the magnetic field is measured thermometrically. By this means it is possible to measure the field intensity to a minimum of 1 oersted and the curve of distribution of magnetic intensity along the wire can also be found. The graphs show that the thermometer indicates the rise of temperature at the nodes of the magnetic field. In the experiments the electric field at these points attained a value of 2500 V/cm. and exerted an influence on the thermometer, which, graduated for a given frequency, was easily used for other frequencies. A mercury thermometer of special design was used. S. G. B.

4410. Method for National Magnetic Surveys. M. Toperczer. *Gerlands Beitr. z. Geophys.* 45. 1–2. *pp.* 184–188, 1935.—At a comparatively small number of well-distributed stations the magnetic elements should be determined with the utmost accuracy; at intervening points the less accurate results of the field-balance are to be checked and corrected by means of the variometer, giving differences in intensity between these and two or more accurate stations. C. A. S.

See also Abstracts 4109, 4110, 4111, 4118, 4119, 4160, 4235, 4306, 4322, 4358, 4391, 4418.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4411. Physico-Mathematical Aspects of Nerve Conduction. N. Rashevsky. *Physics*, 6. *pp.* 308–314, *Sept.*, 1935.—In continuation of a previous paper [see Abstract 4687 (1933)] the equation of propagation of a nerve impulse is studied under more general assumptions about the physical mechanism of excitation. Instead of H. A. Blair's excitation formula, used previously, a more general formula, proposed by the author elsewhere and having several advantages, is considered. It is found that in this case the velocity of propagation is not *strictly* constant, but tends asymptotically to a constant value which is reached practically within 10^{-3} sec. after the propagation of the impulse begins, and the initial velocity is only slightly different from it. The expression for this asymptotic value is in the first approximation identical with the expression deduced previously, and, as the latter, agrees with experimental data. AUTHOR.

See also Abstracts 4153, 4296.

OSCILLATIONS.

4412. Motion of Electrons in Electric and Magnetic Fields and Action of Space Charge. S. J. Braude. *Phys. Zeits. d. Sowjetunion*, 7. 5–6. *pp.* 565–571, 1935. *In English.*—The classical theory of the action of valves involves a knowledge of the potential distribution round the collector and the influence of space charges on this distribution. In the case of magnetrons the paths of the electrons are curved and potential distributions are more difficult to find. The present investigation concerns valves of special shape consisting of two infinite planes, one emitting electrons and the other serving as anode. The necessary equations are set up and a method of solution is given. It is shown that the space charge near the kathode is increased by a magnetic field. G. E. B.

See also Abstracts 4199, 4319, 4337, 4354.

PHOTOELECTRICITY.

***4413. Current-Voltage Relations in Blocking-Layer Photo-Cells. L. A. Wood.** *Rev. Sci. Instruments*, 6. *pp.* 196–201, *July*, 1935. The current (0·1 to 10,000 μA) in a Weston photronic blocking-layer cell is determined as a function of illumination (1 to 100,000 lux) and applied p.d. The conditions for maximum external power (observed value about 1 mW) are discussed. The d.c. conductance in the low-resistance direction is deduced and its dependence upon leakage current, illumination and applied p.d. is discussed. Comparison with a Westinghouse Photox cell indicates that non-linearity of the current-voltage characteristic and rectification are not essentials of blocking-layer cells. Below 5 mV the open circuit voltages of both cells are nearly proportional to the illumination; above 50 mV proportional to the logarithm of the illumination. L. A. W.

***4414. Rectifier Photoelectric Cells with Artificially Deposited Barrier Layer. W. C. van Geel and J. H. de Boer.** *Physica*, 2. *pp.* 892–900, *Aug.*, 1935. *In French.*—Rectifier photo-cells were constructed with Se as the semi-conductor, but with a separately deposited barrier layer between the Se and the top film of metal. The substances used for the barrier layer were MgO, CaF_2 and artificial resin. The photoelectric current i, for a constant voltage across the cell, and the illumination L were found to be related by the equation $i = AL^{2/3}$ in every case. For ordinary photo-conductive cells made with Se deposited and treated in the same way as in the rectifier cells, the relation $i = BL^{1/2}$ was found to hold. D. H. F.

See also Abstracts **4234**, **4240**, **4385**.

PIEZOELECTRICITY.

4415. Experiments on Piezoelectricity. G. Greenwood. *Zeits. f. Krist.* 91. *pp.* 235–242, *Sept.*, 1935. *In English.*—Crystals of several substances were tested for piezoelectricity by the method described in a previous paper [see Abstract 2521 (1932)]. In general the results confirm the observations and predictions of other workers, but some substances hitherto regarded as being piezoelectric yield negative results. P. V.

THERMIONICS.

4416. Relation between the Electron Field Emission and the Work Function of Liquid Mercury. L. R. Quarles. *Phys. Rev.* 48. *pp.* 260–264, *Aug.* 1, 1935.—The variation in the field necessary to initiate a vacuum discharge between a Hg kathode and a Mo anode and the accompanying variation in the work function of the kathode have been measured. The work function variations were obtained from measurements of the contact potential between the Hg and a Pt filament. The fields were applied by an impulse circuit, the time constant of the voltage wave being very short in order to prevent distortion of the Hg. The final results show a variation of the field with work function which, while in the same direction, is more pronounced than that forecast by the Fowler-Nordheim theory. For a change of work function of one volt the field required to initiate the discharge varied from 375 kV/cm. to 575 kV/cm. AUTHOR.

THERMOELECTRICITY.

4417. Thermodynamic Foundations of the Theory of Electric Equilibrium and of Permanent Currents in Metallic Conductors. F. Odone. *Accad. Lincei, Atti,* 21. *pp.* 515–521, *April* 7, 1935.—The author considers the fundamental thermodynamical ideas associated with the principal electrical phenomena presented by the equilibrium of electric charges and by permanent electric currents flowing in metallic conductors. He considers appropriate formulæ for the internal energy and the entropy in such cases and emphasises the importance of the distinction between compensated and non-compensated heat. A. J. McC.

4418. Variation with Magnetic Field and Temperature of the Thermoelectric Properties of Ferromagnetics. F. E. Lowance and F. W. Constant. *Phys. Rev.* 48. *pp.* 257–260, *Aug.* 1, 1935.—A survey of the work previously done on this subject and an experimental investigation of a more extended nature than any heretofore have been attempted in order to clear up existing confusion and render the subject more available to theoretical interpretation. Measurements on Fe, Ni, Co and permalloy from room-temperature to above the Curie point indicate

that the e.m.f. produced by a magnetic field in these thermocouples is conditioned by (1) the crystal structure and (2) the change in direction of the resulting spins or intrinsic magnetisation in separate crystal regions, and that this effect is related to the change in length on magnetisation.
AUTHORS.

4419. Longitudinal Thermoelectric Effect. Part II. Nickel. T. H. Pi and W. Band. *Phys. Soc., Proc.* 47. *pp.* 852–858, *Sept.* 1, 1935. —The e.m.f. produced by asymmetrical temperature-distributions in a pure nickel wire is examined and found to agree well with the formula [see Abstract 3444 (1934)]. The two constants have the values for $10^9.a = -1\cdot80$ V.-cm./(° C.)^2, $10^{11}.b = 1\cdot85$ V.-cm.^{2}/(° C.)^3, for zero magnetic field. For small fields both constants are reduced in absolute value, reversing sign at 40 gauss, reaching a maximum of this opposite sign at 200 gauss, and thereafter returning asymptotically towards zero. The connection of these results with thermomagnetic phenomena is discussed. [See following Abstract.] AUTHORS.

4420. Longitudinal Thermoelectric Effect. Part III. Aluminium. M. K. Li and W. Band. *Phys. Soc., Proc.* 47. *pp.* 859–861, *Sept.* 1, 1935.—The e.m.f. produced in Al wires is measured by a Paschen galvanometer. The temperature-distribution is analysed by means for the formula [see preceding Abstract], but without success; alternative formulæ also fail. The e.m.f.s observed were less than $0\cdot3\ \mu$V; they were in the same direction as those previously found in copper wire. [See following Abstract.] AUTHORS.

4421. Longitudinal Thermoelectric Effect. Part IV. Aluminium (Continued). W. Band. *Phys. Soc., Proc.* 47. *pp.* 862–872, *Sept.* 1, 1935.—Results obtained in work by Li and Band (see preceding Abstract) are analysed by means of the formula $E = a\int G.dT + b\int G^2.dT + e.DT$, where e is the excess in thermoelectric power of normal aluminium over that of a postulated allotropic form having a transition temperature T_c below 180° C. with delayed reverse transition; DT is the temperature difference between the junctions of the two forms of metal. Excellent agreement for all tensions is found. Under zero tension the values found are $a = +0\cdot6 \times 10^{-11}$ V.-cm./(° C.)^2, $b = +2\cdot2 \times 10^{-13}$ V.-cm.^{2}/(° C.)^3, $e = +0\cdot0067\ \mu$V./°C. The same critical temperature, 79° C., is required for all tensions. Direct experimental tests with cooling-curves, a Paschen galvanometer being used to measure the thermo-e.m.f., verify this temperature exactly. All possible explanations of this transition are carefully discussed, the recrystallisation theory appearing the most probable. Further work is suggested, and the significance of the present results for methods of increasing precision is pointed out. AUTHOR.

4422. Longitudinal Thermoelectric Effect. Part V. Silver. J. L. Ch'en and W. Band. *Phys. Soc., Proc.* 47. *pp.* 904–909, *Sept.* 1, 1935.—Improvements in technique are described by means of which the experimental results become more consistent than before, and the analysis becomes simpler to carry out. The homogeneous thermoelectric constants for silver are found, and their dependence upon longitudinal tension is shown. A critical temperature near 200° C. for zero tension is found at which the thermoelectric constants suffer an abrupt change. Reasons are given for supposing that there is an intimate connection between this transition and the ordinary elastic limit of the wire. AUTHORS.

See also Abstract 4389.